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REMEDIAL ACTION PLAN ELECTRIC POWER PLANT BUILDING 103 NAS KEY WEST FL
8/1/1994
ABB ENVIRONMENTAL SERVICES INC

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REMEDIAL ACTION PLAN

ELECTRIC POWER PLANT, BUILDING 103

NAVAL AIR STATION KEY WEST
KEY WEST, FLORIDA

UNIT IDENTIFICATION CODE (UIC): N00213
NAVY CLEAN - DISTRICT I
CONTRACT NO. N62467-89-D-0317

AUGUST 1994

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
29419-9010

REMEDIAL ACTION PLAN

ELECTRIC POWER PLANT, BUILDING 103
NAVAL AIR STATION KEY WEST
KEY WEST, FLORIDA

Unit Identification Code (UIC): N00213

Contract No. N62467-89-D-0317

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August 1994

FOREWORD

Subtitle I of the Hazardous and Solid Waste Amendments (HSWA) of 1984 to the Solid Waste Disposal Act (SWDA) of 1965 established a national regulatory program for managing underground storage tanks (USTs) containing hazardous materials, especially petroleum products. Hazardous wastes stored in USTs were already regulated under the Resource Conservation and Recovery Act (RCRA) of 1976. Subtitle I requires that the U.S. Environmental Protection Agency (USEPA) promulgate UST regulations. The program was designed to be administered by individual States, who were allowed to develop more stringent, but not less stringent standards. Local governments were permitted to establish regulatory programs and standards that are more stringent, but not less stringent than either State or Federal regulations. The USEPA UST regulations are found in the Code of Federal Regulations, Title 40, Part 280 (40 CFR 280) (*Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks*) and 40 CFR 281 (*Approval of State Underground Storage Tank Programs*). 40 CFR 280 was revised and published on September 23, 1988, and became effective December 22, 1988.

The Navy's UST program policy is to comply with all Federal, State, and local regulations pertaining to USTs. This report was prepared to satisfy the requirements of Chapter 17-770, Florida Administrative Code (FAC) (*State Underground Petroleum Environmental Response*) regulations on petroleum contamination in Florida's environment as a result of spills or leaking tanks or piping.

Questions regarding this report should be addressed to the Commanding Officer, Naval Air Station, Key West, Florida, or to Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), Code 1842, at 803-743-0307 (AUTOVON 563-0307).

EXECUTIVE SUMMARY

The purpose of this Remedial Action Plan (RAP) is to present a plan for remediation of petroleum contamination at Building 103, Truman Annex (Site 103) at Naval Air Station Key West, Key West, Florida. The RAP presented herein is designed for implementation at Site 103 and, when implemented, will result in a reduction of the level of petroleum-related contamination in the soil in accordance with the requirements of Chapters 17-770 and 17-775, Florida Administrative Code (FAC).

This RAP sets forth a procedure of excavation and destruction of contaminated soil at Site 103. The area to be excavated is also associated with the existing free product. Free product recovery is proposed through direct excavation and product pumping if necessary. Containment of the existing groundwater contamination and natural attenuation are expected to continue, but a monitoring program will be implemented for assurance.

This RAP presents the rationale for the remedial actions to be implemented at Building 103. Implementation of remedial actions described in this RAP will include the following tasks:

- excavation of contaminated soil in the area surrounding monitoring well MW-14 to a depth approximately 1 foot below the water table,
- disposal of the contaminated soil by offsite thermal treatment, and
- product recovery in the excavated area as necessary.

ACKNOWLEDGMENTS

In preparing this report, the Underground Storage Tank personnel at ABB Environmental Services, Inc., acknowledges the support, assistance, and cooperation provided by the personnel at Naval Air Station (NAS) Key West and Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM).

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Naval Air Station Key West
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<u>GLOSSARY</u>

ABB-ES	ABB Environmental Services, Inc.
ASTM	American Society for Testing and Materials
BTEX	benzene, toluene, ethylbenzene, and xylenes
bls	below land surface
CA	contamination assessment
CAR	Contamination Assessment Report
CARA	CAR Addendum
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action, Navy
cm/s	centimeters per second
CTO	Contract Task Order
CNO	Chief of Naval Operations
DFM	diesel fuel marine
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FDER	Florida Department of Environmental Regulation
ft^2	square feet
ft^3	cubic feet
ft/day	feet per day
GC	gas chromatograph
GC/MS	gas chromatography/mass spectroscopy
gpm	gallons per minute
HSWA	Hazardous and Solid Waste Amendments of 1984
I	hydraulic gradient
K	hydraulic conductivity
kg	kilogram
mg	milligrams
mg/ℓ	milligrams per liter
msl	mean sea level
MLW	mean low water
μg/ℓ	micrograms per liter
NAS	Naval Air Station
NGVD	National Geodetic Vertical Datum of 1929
NPDES	National Pollution Discharge Elimination System
NSC	Naval Supply Center
O&M	operation and maintenance
OVA	organic vapor analyzer

<u>GLOSSARY</u> (Continued)

PAHs	polynuclear aromatic hydrocarbons
ppb	parts per billion
ppm	parts per million
RAC	Remedial Action Contractor
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
SOUTHNAV-FACENGCOM	Southern Division, Naval Facilities Engineering Command
SVE	soil vapor extraction
SVOC	semivolatile organic compounds
SWDA	Solid Waste Disposal Act of 1965
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
UIC	uniform identification code
USCS	Unified Soil Classification System
USEPA	U.S. Environmental Protection Agency
UST	underground storage tank
UV	ultraviolet
V	velocity
VOA	volatile organic aromatic
VOCs	volatile organic compounds
yd^3	cubic yards

1.0 INTRODUCTION

A Contamination Assessment Report (CAR) for Building 103 at Naval Air Station (NAS) Key West, Florida, was submitted by ABB Environmental Services, Inc. (ABB-ES), in September 1992 to Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM). A CAR Addendum (CARA) was submitted in September 1993. After approval of the CARA by Florida Department of Environmental Protection (FDEP), ABB-ES was authorized by SOUTHNAVFACENGCOM to develop a Remedial Action Plan (RAP). This work is being performed under Contract Task Order (CTO) No. 007 of the Comprehensive Long-term Environmental Action, Navy (CLEAN) contract.

1.1 PURPOSE. The purpose of this RAP is to present a plan for remediation of petroleum contamination at Building 103, Truman Annex (Site 103). The RAP presented herein is designed for implementation at Site 103 and, when implemented, will result in a reduction of the level of petroleum-related contamination in the soil in accordance with the requirements of Chapters 17-770 and 17-775, Florida Administrative Code (FAC).

1.2 SCOPE. This RAP presents the rationale for the remedial actions to be implemented at Building 103. Implementation of remedial actions described in this RAP will include the following tasks:

- excavation of contaminated soil in the area surrounding monitoring well MW-14 to a depth approximately 1 foot below the water table,
- disposal of the contaminated soil by offsite thermal treatment, and
- product recovery to capture free product in the excavated area if necessary.

2.0 BACKGROUND

2.1 SITE DESCRIPTION. Naval Air Station Key West (NAS Key West) is located approximately 150 miles southwest of Miami in Monroe County, Florida (Figure 2-1). NAS Key West, a complex of activities located in numerous areas of the Lower Florida Keys, encompasses approximately 5,000 acres. The majority of these activities are concentrated on Boca Chica Key and Key West. The mission of NAS Key West is to maintain and operate facilities and provide services and materials to support operations of aviation activities and units designated by the Chief of Naval Operations (CNO). The site is located on Key West at the Electric Power Plant, Building 103, in Truman Annex (Figure 2-2).

The turning basin, where ships are docked and serviced, is located in the western part of the station. The Electric Power Plant, Building 103, is located adjacent to the bulkhead along the eastern part of the turning basin.

2.2 SITE HISTORY. Building 103 was formerly the Electric Power Plant for the Truman Annex facility. The initial area of concern was the former location of a lubricating oil underground storage tank (UST), located on the north side of Building 103. In January 1991 after a heavy rain, petroleum product was observed on the land surface over the location of the lubricating oil UST. The UST was excavated and removed from the site. During tank removal activities, free product was observed floating on the water in the excavation pit. According to Navy personnel, petroleum-contaminated soil was removed from the UST excavation, stockpiled adjacent to the excavation pit, and returned to the excavation after the UST was removed. The former tank location is designated as the "UST excavation" in Figure 2-2.

The UST contained "clean" lubricating oil for the generators in Building 103. The UST was connected to a system of piping where generator lubricating oil was recycled by centrifuging the oil to remove condensation (water) and any fuels with which it may have had contact.

The remaining area around Building 103, in the past, contained pipelines (wharf area) and storage tanks (east) that contained petroleum. Petroleum products that have been used in the past at Truman Annex have been predominantly fuel oils (Bunker C and Diesel Fuel Marine) and, to a lesser extent, lubricating oil. There are existing underground utilities throughout the pier area. These utility lines include fuel and oily waste steel pipelines, electrical, stormwater, wastewater, sanitary sewer, potable water, steam, and compressed air lines.

The bulkhead adjacent to Site 103 is an addition to the turning basin bulkhead. A 1,200-foot section of the bulkhead was extended 30 feet into the turning basin in the late 1980's. The pier is constructed of a single wall of PZ steel sheet piling with a 3-inch concrete encasement. The wall was driven to various depths, generally extending to 53 feet below mean sea level (msl). The dredge depth is approximately 33 feet below msl. The original bulkhead was driven to various depths, generally extending to 23 feet below the msl, with a dredged depth of about 13 feet below msl.

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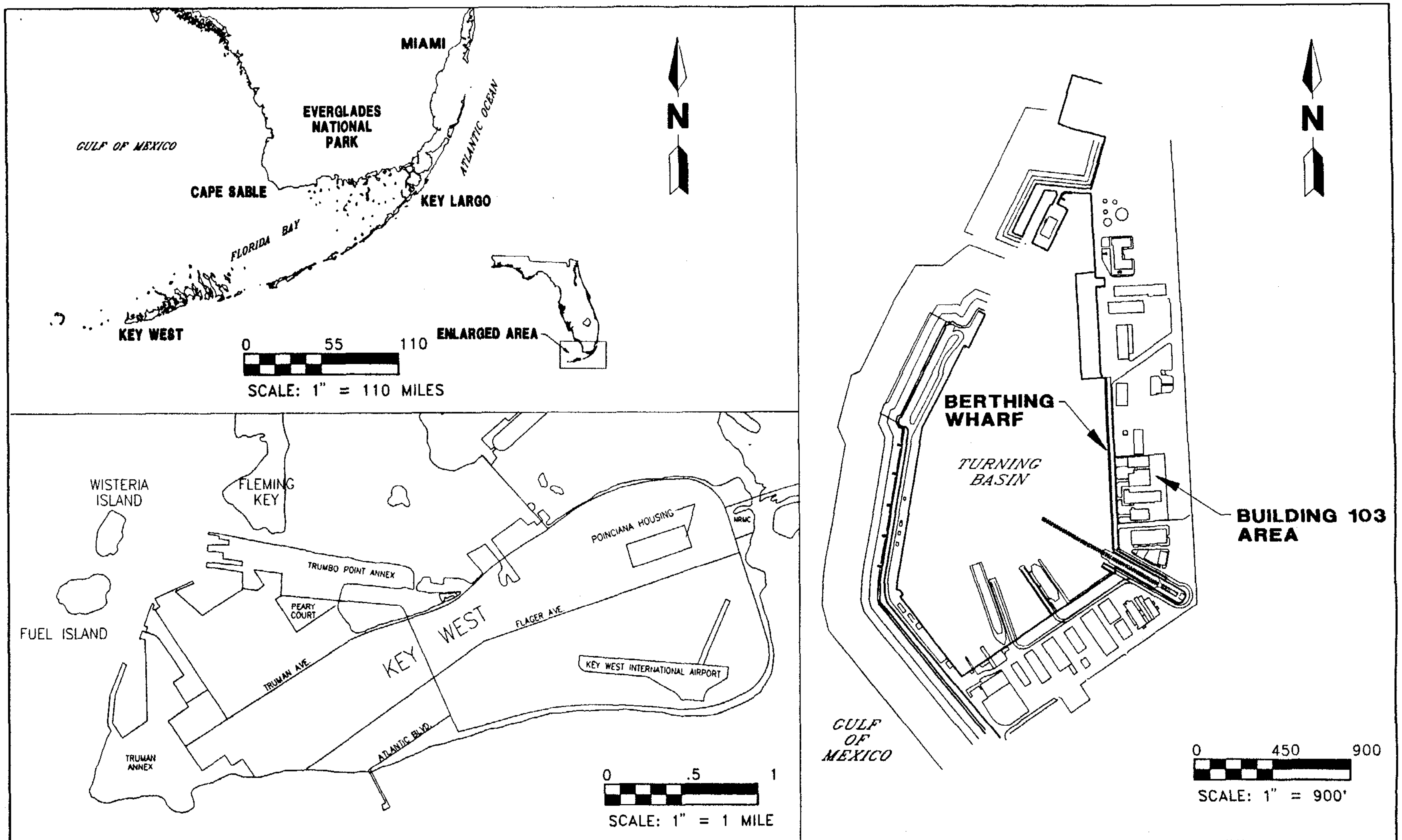

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FIGURE 2-1
FACILITY LOCATION MAP

REMEDIAL ACTION PLAN
BUILDING 103

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

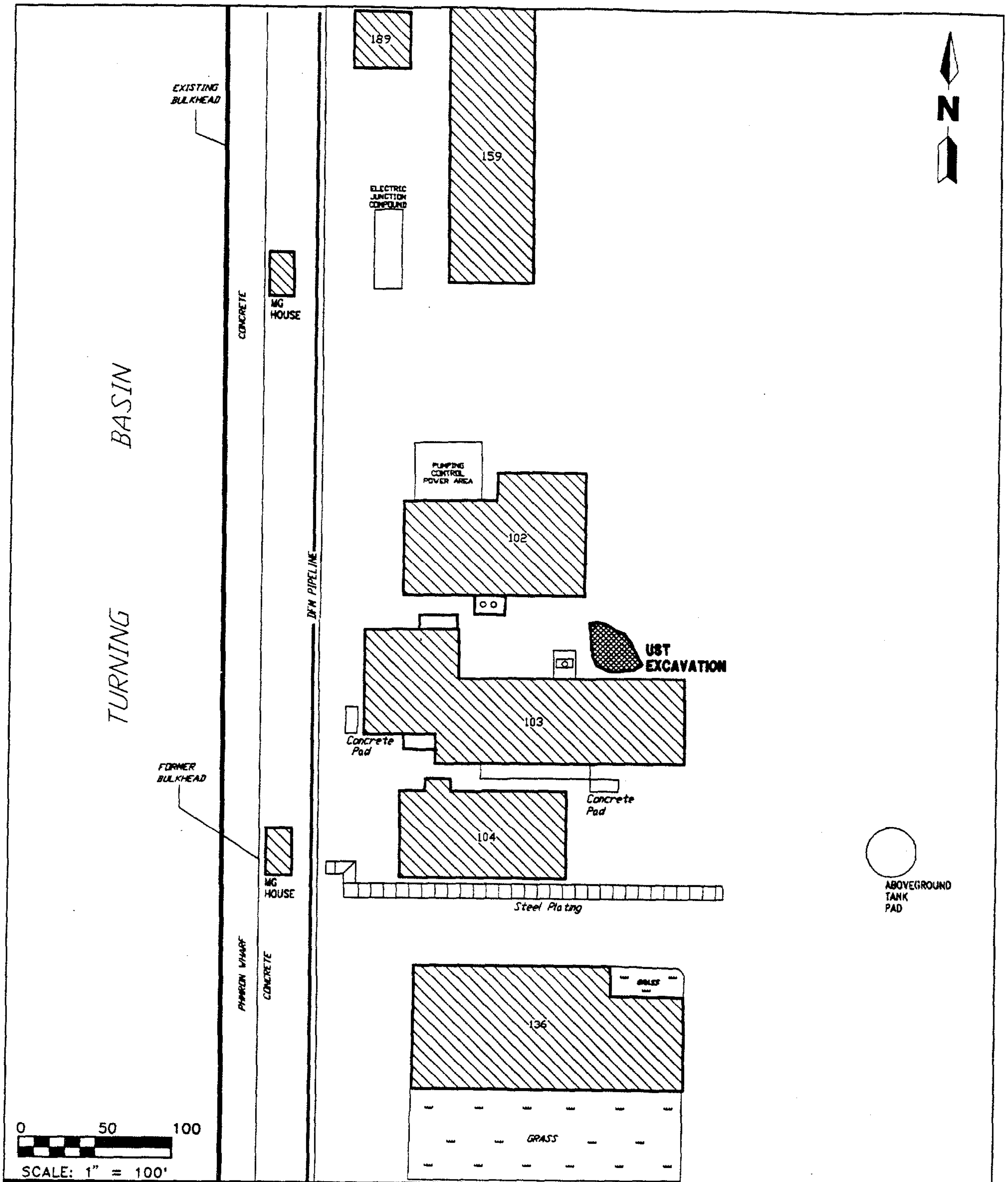

FIGURE 2-2
SITE MAP

REMEDIATION ACTION PLAN
BUILDING 103

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

2.3 SUMMARY OF CONTAMINATION ASSESSMENT REPORT (CAR) AND CAR ADDENDUM (CARA) FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS. As a result of the observation of product in the UST excavation, a Contamination Assessment (CA) was initiated in August 1991 and supplemented in April 1992. A CAR was submitted in June 1992 to the Florida Department of Environmental Regulation (currently the FDEP). At the request of FDEP, supplemental field investigative activities were conducted at the site. These activities were conducted through August 1993. A CARA was submitted in September 1993. The objectives of the CA were to identify petroleum contaminants and their likely sources at the site, assess the degree and extent of petroleum contamination in the soil and the groundwater, and recommend remedial actions, if necessary, to attain compliance with State regulations.

Fifty-nine soil gas sample sites, 78 soil boring, 29 shallow monitoring wells, 1 intermediate monitoring well, and 1 deep monitoring well were advanced or installed at the site. Soil gas samples, organic vapor analyzer (OVA) samples, gas chromatograph (GC) samples, and soil and groundwater quality samples were collected. Soil and groundwater quality samples were analyzed for the kerosene analytic group as defined in Chapter 17-770, FAC. The findings, conclusions, and recommendations of the CAR and CARA are summarized below.

2.3.1 CAR and CARA Findings

- Results of OVA headspace analyses indicate excessive soil contamination at the site in three isolated areas. One area is located in the vicinity of monitoring well MW-14, a second area is in the vicinity of the former lubricating oil UST, and a third area is along the western side of Building 102.

- Total recoverable petroleum hydrocarbon (TRPH) analytical results indicate petroleum contamination is present in turning basin bottom sediments collected along the bulkhead on the west side of the site. The extent of TRPH contamination in the sediments has not been delineated to the north; however, a bottom sediment sample taken from the turning basin at a nearby site (approximately 300 feet north of SB-74) also contained high levels of TRPH (ABB-ES, 1993). This indicates the background levels of TRPH in the turning basin sediments may exceed State target levels.

- TRPH concentrations detected in the turning basin bottom sediment samples collected along the bulkhead do not correspond with the direction of groundwater contaminant migration or areas of soil contamination at the site. High TRPH concentrations were detected in areas where no groundwater contamination was detected. For example, the highest TRPH soil concentration was detected in the sample collected from soil boring SB-74, which is located directly west of monitoring well MW-30, in which no groundwater contaminants were detected. It is likely that the source of TRPH in the turning basin sediments is the result of previous naval activities and are not related to petroleum contamination at Site 103.

- The concrete bulkhead extends to a depth of 53 below msl, inhibiting petroleum migration into the turning basin sediments.

- Groundwater flow direction is subject to reversals based on tidal influence; however, the predominant general groundwater flow direction at the site appears to be toward the west.

- There are no known potable wells in the Key West area (McKenzie, 1990).

- The surficial aquifer in the Key West area is classified as a G-III (non-potable) groundwater source.

- Free petroleum product was detected in monitoring well MW-14 on August 25, 1993. The estimated areal extent of free product contamination is restricted to a small area of the site in the vicinity of an abandoned storage tank pad. The area of excessively contaminated soil in the vicinity of monitoring well MW-14 roughly corresponds to the extent of free product.

- TRPH, lead, chromium, total volatile organic aromatic (VOA), and cadmium concentrations exceed applicable State target levels in groundwater samples collected at the site. In addition, elevated concentrations of polyaromatic hydrocarbon (PAH) and total naphthalene were detected in monitoring wells with TRPH concentrations exceeding State target levels for Class G-III groundwater.

- The areal extent of total VOA groundwater contamination exceeding the State Class G-III groundwater target level of 200 parts per billion (ppb) is restricted to the vicinity of monitoring well MW-28.

- The areal extent of TRPH groundwater contamination exceeding the State target level of 5 parts per million (ppm) for Class G-III groundwater is larger than the other areas of contamination. TRPH contamination extends from the vicinity of monitoring well MW-14 west to the bulkhead. The highest TRPH concentrations were detected in groundwater samples collected from monitoring wells MW-14 and MW-27.

- Although there are no State target levels for PAH or total naphthalene in Class G-III groundwater, results of groundwater laboratory analyses indicate areas where PAH and total naphthalene concentrations exceed 100 ppb. One area where total naphthalene concentrations exceed 100 ppb is in the vicinity of monitoring well MW-14. Another larger area where both PAH and total naphthalene concentrations exceed 100 ppb is in the vicinity of Building 103 in the western section of the site.

- Lead concentrations exceed the State target cleanup levels for Class G-III groundwater of 50 ppb in groundwater samples collected from monitoring wells MW-13 and MW-27, located near the southwest corner of Building 102. Lead was also detected in the groundwater sample collected from monitoring well MW-25 in the southeast section of the site. The concentration of lead detected in the duplicate sample collected from monitoring well MW-25 is below the State target level.

- Cadmium and chromium concentrations detected in the groundwater sample collected from MW-27 exceed the State target cleanup levels of for Class G-III groundwater. The areal extent of cadmium groundwater contamination, however, is restricted to the vicinity of monitoring well MW-27. Neither cadmium nor chromium were detected in any other groundwater samples.

2.3.2 CAR and CARA Conclusions

- Comparisons of groundwater analytical results for the period August 1991 to June 1993 indicate groundwater contamination has generally decreased at Site 103.

- Total VOA and metals contamination appears to be restricted to the site. However, it appears that total naphthalene (and PAH) and TRPH groundwater contamination is migrating west toward the turning basin.

- There is evidence that indicates the concrete bulkhead is inhibiting the migration of groundwater contaminants from Site 103 into the turning basin.

- No contamination was detected in the surface water sample collected along the bulkhead, which is directly downgradient of the total naphthalene and TRPH plume.

- No contamination was detected in monitoring well MW-31D, which is located in the plume and is screened from 50 to 55 feet below land surface (bls). The bulkhead extends to a depth of 60 feet bls. Petroleum contamination migrating beneath the bulkhead into the turning basin would be detected in samples collected from MW-31D.

2.3.3 CAR and CARA Recommendations Based on the findings and conclusions of this investigation, the following actions were recommended:

- free product removal and groundwater remediation in the vicinity of monitoring well MW-14;

- soil remediation in the areas of excessive soil contamination;

- groundwater remediation in the vicinity of monitoring well MW-27;

- groundwater remediation in the vicinity of the former lubricating oil UST, near monitoring well MW-3;

- semiannual groundwater monitoring of total VOA concentrations in monitoring wells MW-1, MW-12, MW-27, and MW-28 for a period of 2 years;

- semiannual groundwater monitoring of total naphthalene and PAH concentrations in monitoring wells MW-1, MW-8, MW-12, MW-20I, MW-27, and MW-28 for a period of 2 years;

- semiannual groundwater monitoring of TRPH concentrations in monitoring wells MW-1, MW-4, MW-5, MW-7, MW-14, MW-26, and MW-27 for a period of 2 years; and

- semiannual groundwater monitoring of lead concentrations in monitoring wells MW-13, MW-25, MW-26, and MW-27 for a period of 2 years.

If contaminant levels drop below State target levels at the end of the monitoring period, a No Further Action Proposal (NFAP) will be submitted. If contaminant levels persist above State target levels, then additional monitoring or remediation may be required.

3.0 REMEDIAL ALTERNATIVES

3.1 CONTAMINANTS OF CONCERN. The contaminants of concern for Site 103 are associated with a limited area of free product contamination. This area also contains soil that is excessively contaminated at a depth greater than 3 feet bls. Groundwater contamination is not a concern at Site 103 as the groundwater is contained and the exposure pathways are limited. Discussions regarding these issues follow.

3.1.1 Free Product and Soil Free product was detected during the CARA in monitoring well MW-14 on August 25, 1993. The area of expected free product contamination is associated with the area of contaminated soil in the vicinity of MW-14 as shown in Figure 3-1.

The CA indicates that soil contamination is present in three isolated areas (Figure 3-2). One area is located in the vicinity of soil boring SB-72, which corresponds to monitoring well MW-14, a second area is in the vicinity of the former lubricating oil UST, and the third area is an elongated area near the western edge of Building 102 in the vicinity of monitoring wells MW-7, MW-8, and MW-13.

Exposure pathways through the soil media are limited; the latter two areas are not considered to contain contaminants of concern. Evidence for this was obtained from OVA soil data from the 1991, 1992, and 1993 field investigations that were combined to assess the vertical extent (bls) of soil contamination and to assess the present exposure risk. A summary of the latest analytical results for OVA readings can be found in Appendix A.

The vertical extent of contamination occurs almost exclusively at depths greater than 3 feet bls. Only one OVA reading (SB-44) was found in excess of 50 ppm for the 0 to 1 foot depth interval (Figure 3-3). In the depth interval from 1 to 3 feet no excessively contaminated soil was identified (Figure 3-4). On this basis, the potential for exposure is not present under normal circumstances. Only the contaminated soil that is associated with free product will be considered for remedial action.

3.1.2 Groundwater Contamination The Chapter 17-770, FAC, kerosene analytical group of contaminants, the contaminant migration potential, and future groundwater usage will be the basis for the groundwater remedial consideration. Possible contaminant migration via the groundwater into the turning basin should be weighed along with the possibility of exposure due to the use of groundwater wells in the area.

The surficial aquifer at the site is brackish. The local surficial aquifer is a combination of two formations that combine to create a single unconfined (water table) aquifer with a thickness of approximately 300 feet. The surficial aquifer contains a small freshwater lens that floats on the saline groundwater. The lens, which is very thin (from less than 1 foot near the edge to an average of 5 feet near the center), is located below the center of the western half (Old Town) of the island. The water table fluctuates and the configuration of the lens constantly changes, largely as a result of tidal action. On the average the lens is approximately 8,000 feet in length by 4,000 feet in width. Water quality data indicate that the lens is an unlikely source of potable water (McKenzie, 1990).

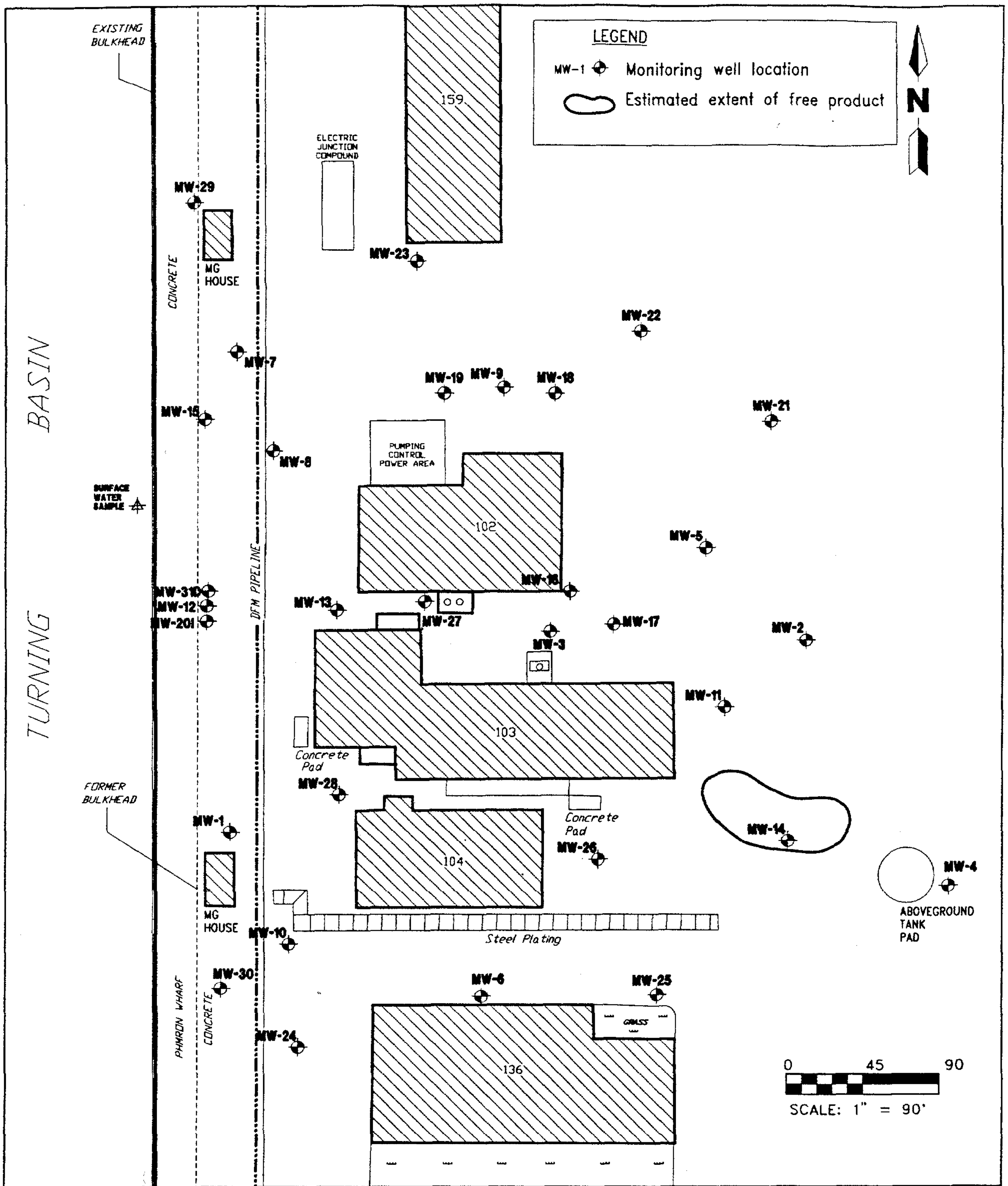

FIGURE 3-1
APPROXIMATE AREA OF FREE PRODUCT

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BUILDING 103

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

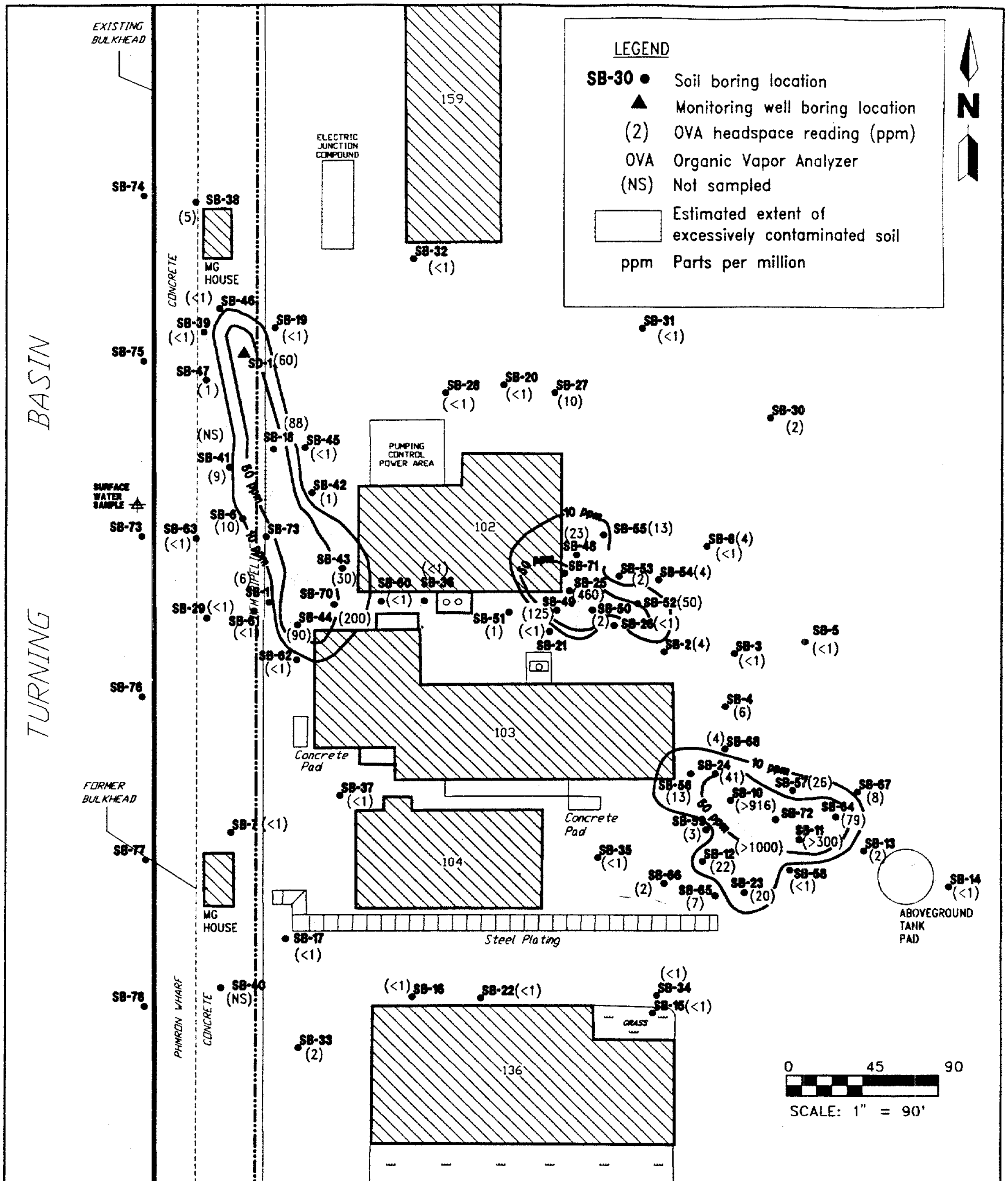

FIGURE 3-2
SOIL CONTAMINATION DISTRIBUTION MAP

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BUILDING 103

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

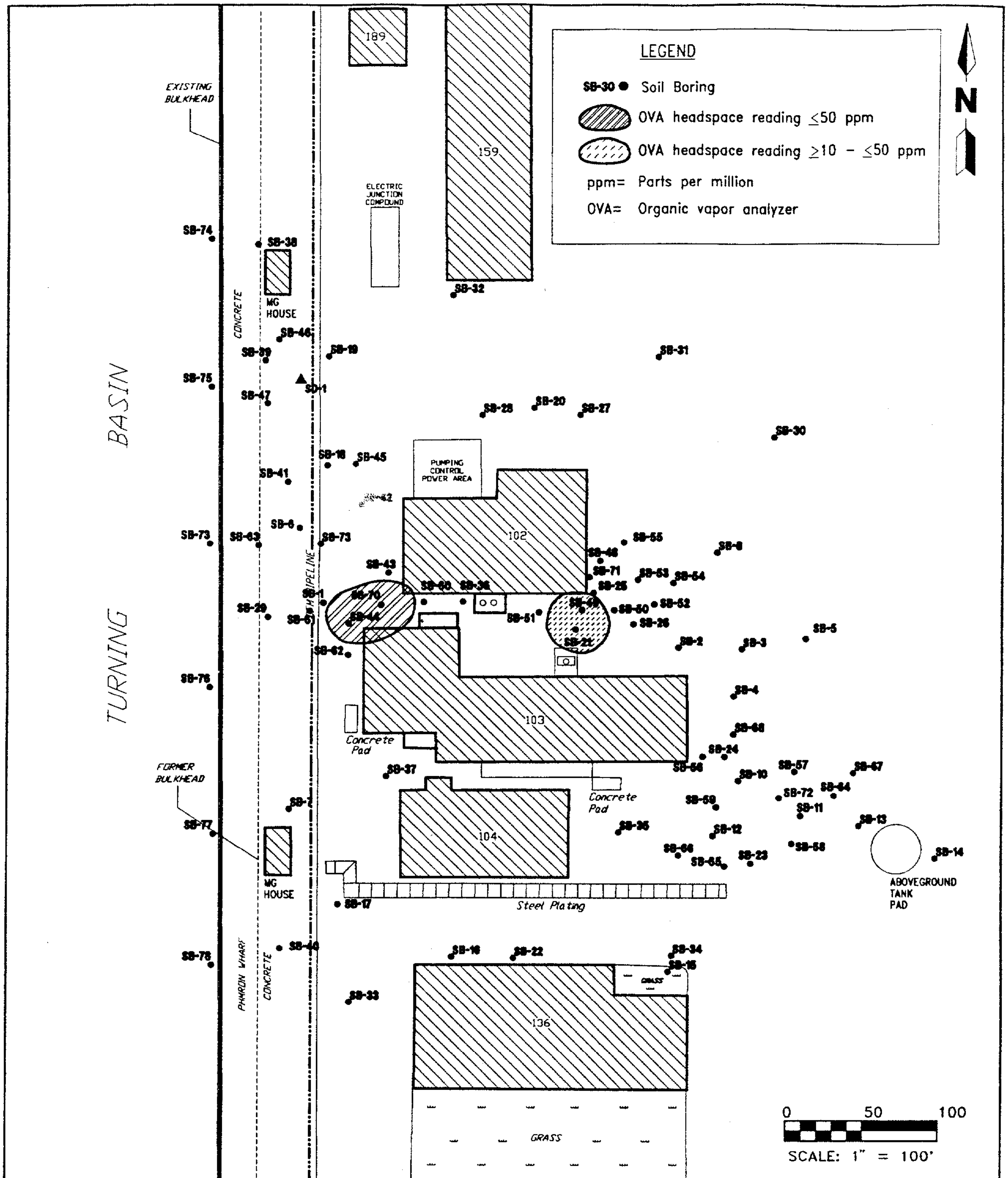

FIGURE 3-3
SOIL CONTAMINATION DISTRIBUTION, 0 TO 1 FOOT BELOW LAND SURFACE

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KEY WEST, FLORIDA

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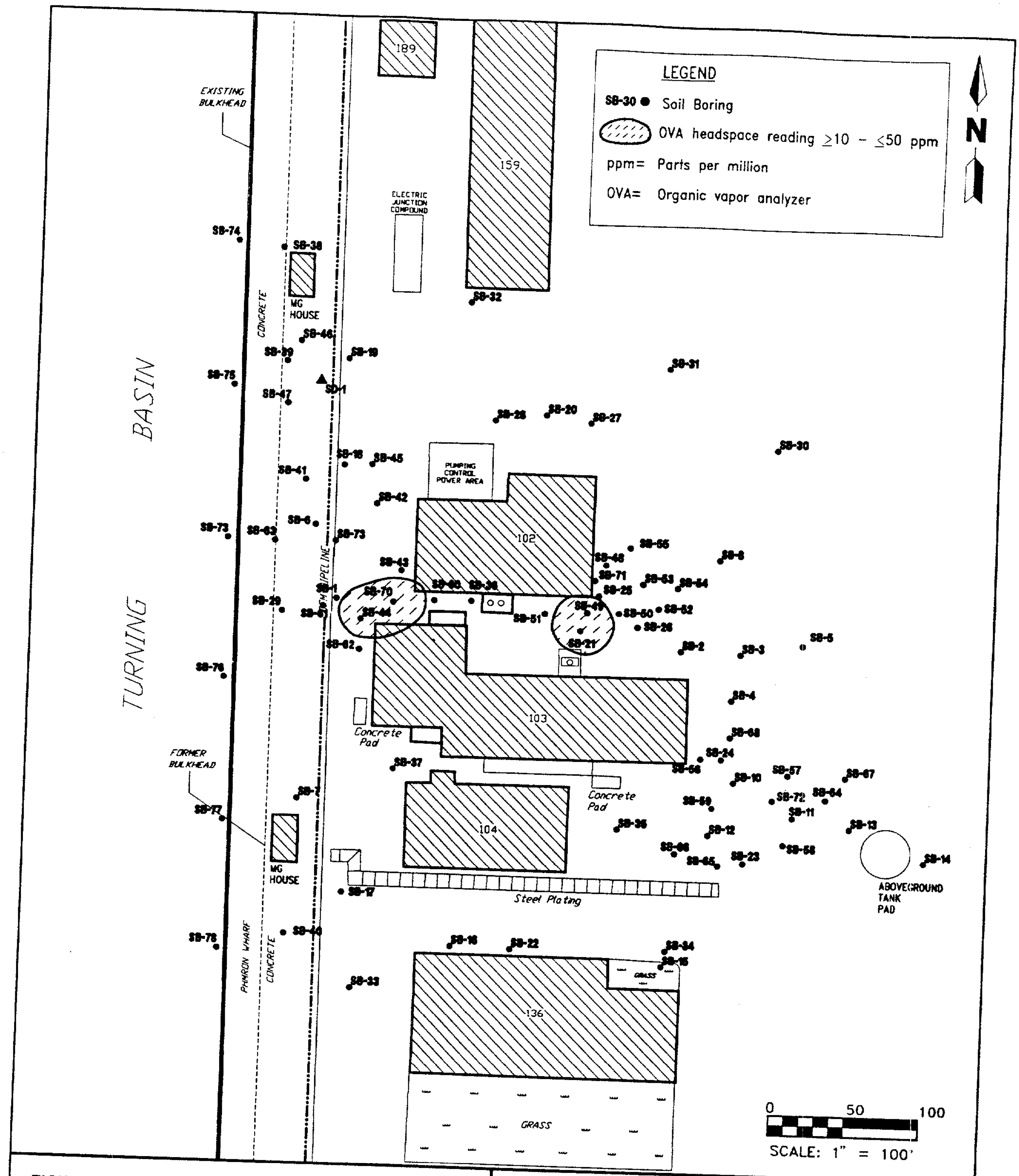

FIGURE 3-4
SOIL CONTAMINATION DISTRIBUTION, 1 TO 3 FEET BELOW LAND SURFACE

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KEY WEST, FLORIDA

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The surficial aquifer at the site is not potable and is classified under Chapter 17-3, FAC, as G-III. From the findings of the 1991 and 1992 CA field investigations, no potable wells were identified within a 0.25-mile radius of the site. Key West presently acquires potable water from the mainland via the Florida Aqueduct and use of the groundwater for drinking water purposes is not a major concern.

The contaminated groundwater at Site 103 poses no threat to the surrounding area and is considered to be contained. Groundwater flow direction in the surficial aquifer is subject to direction reversals from tidal influence; however, the predominant general groundwater flow direction at the site appears to be toward the west. Eastward shifts occur in the immediate vicinity of the bulkhead wall during periods of high water elevations. Groundwater elevation contour maps are shown in Figures 3-5 and 3-6. This continuous shifting combined with the vertical movement associated with the rise and fall of the water table aid in plume containment.

A chief concern at Site 103 is the potential for contaminant migration into the turning basin. The bulkhead wall is acting as a barrier for any transport of contamination into the turning basin. Evidence for this is provided in the CAR or CARA and through testing performed on PZ sheet piles to determine their approximate hydraulic conductivity (Starr and others, 1992). Figure 3-7 displays a cross sectional view of the new bulkhead wall. Hot rolled steel PZ sheet piling with conventional unsealed joints, as used in the bulkhead construction, typically has a hydraulic conductivity on the order of magnitude of 10^{-7} centimeters per second (cm/s). Periodic inspections of the existing bulkhead are conducted every 2 to 3 years.

Correspondence with the FDEP regarding the issue of groundwater were conducted prior to any final decisions involving groundwater remedial considerations. Documentation of these issues are shown in Appendix B. Results show that all parties are in agreement that groundwater contamination is not a remedial concern provided that assurance for the limited migration and the safety of the surface water in the turning basin is given. It should also be shown that there are no potable wells in the area. These areas of concern were covered in detail in the preceding paragraphs and, to conclude, because the groundwater contamination is contained and its exposure pathways are negligible, groundwater contaminants are not considered primary contaminants of concern and will not be considered further.

3.2 APPLICABLE CLEANUP STANDARDS. Free product in the vicinity of MW-14 should be removed. Soil contamination should be addressed with primary consideration given to the petroleum-saturated soil that corresponds to free product contamination (Figure 3-1). Standards and regulations regarding required remedial goals for soil are contained in the *Guidelines for Assessment and Remediation of Petroleum Contaminated Soil* (FDEP, 1994) and should be applied following treatment by any method. Table 3-1 provides the organic standards for clean soil, and Table 3-2 gives the metal standards for clean soil.

3.3 EXTENT OF CONTAMINATION. Presently, there are no known active sources of petroleum contamination. All storage tanks have been removed and fuel carrying pipes are currently inactive. The extent of contamination requiring remediation at Site 103 is limited to the contaminated soil that is associated with free

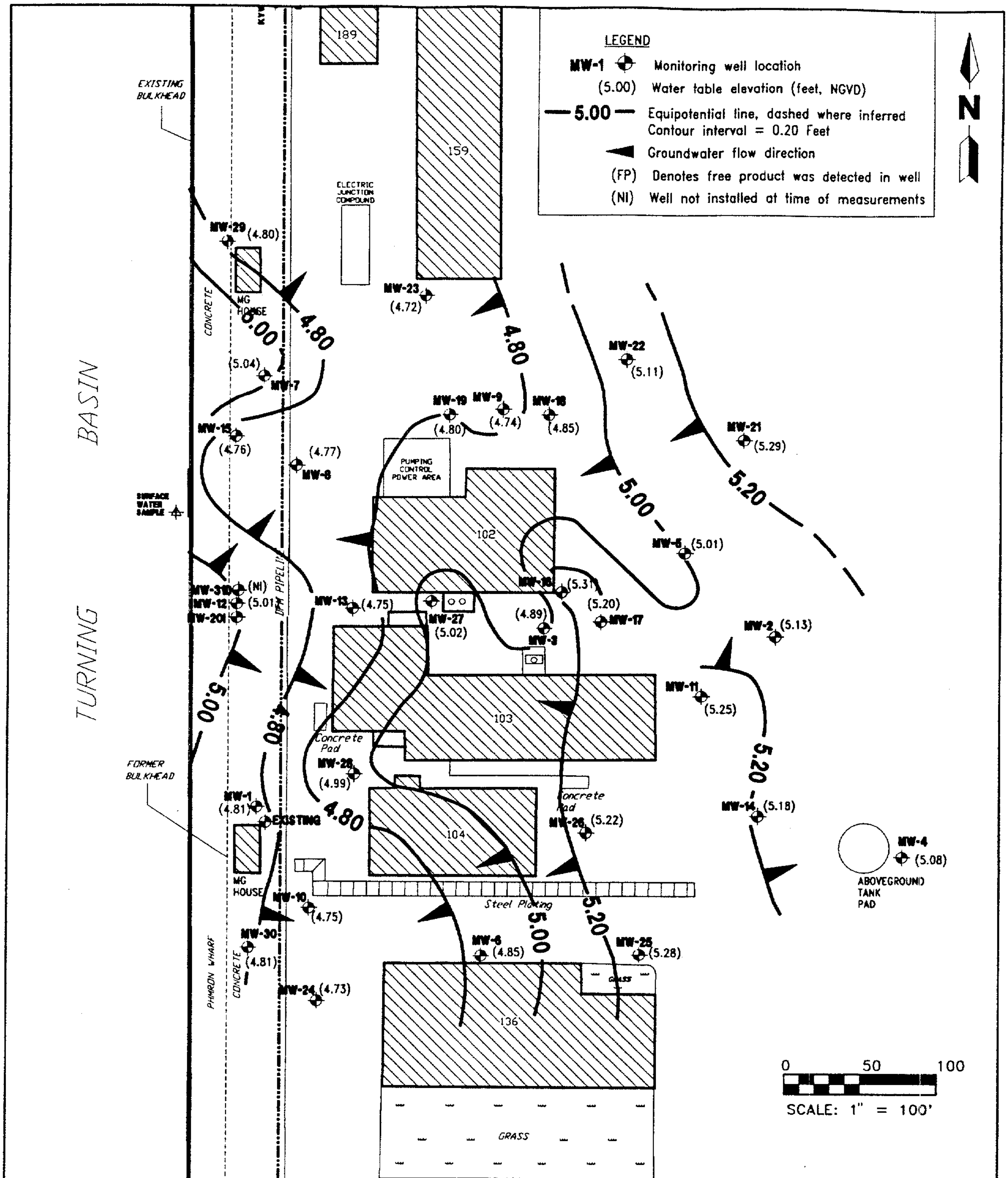

FIGURE 3-5
GROUNDWATER ELEVATION CONTOUR MAP, SURFICIAL ZONE, MARCH 28, 1993

KEYWEST\BLDG-103\WDW\08-24-94

SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

REMEDIAL ACTION PLAN
BUILDING 103

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

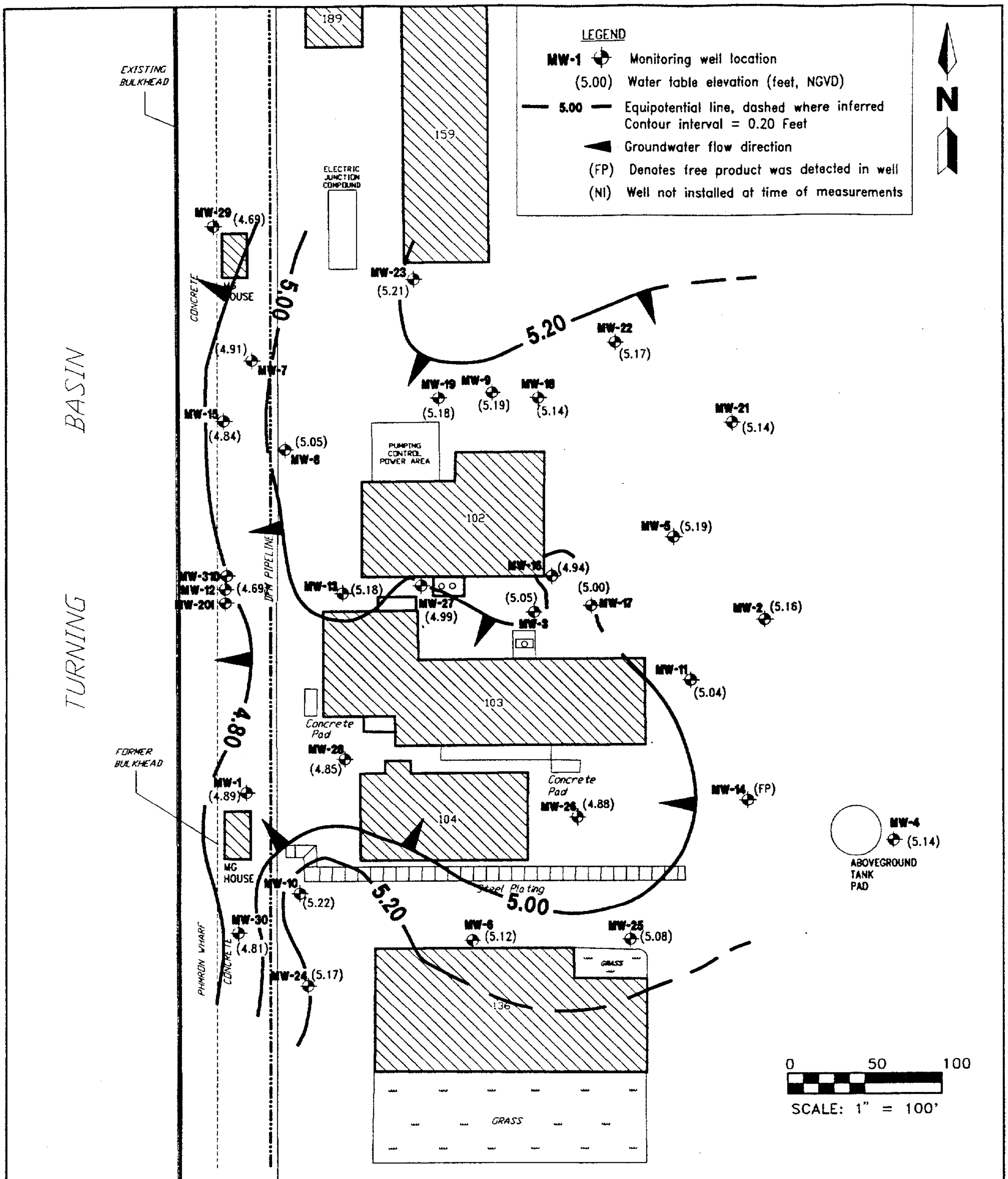

FIGURE 3-6
GROUNDWATER ELEVATION CONTOUR MAP, SURFICIAL ZONE, AUGUST 25, 1993

KEYWEST\BLDG-103\WDW\08-24-94

REMEDIAL ACTION PLAN
BUILDING 103

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

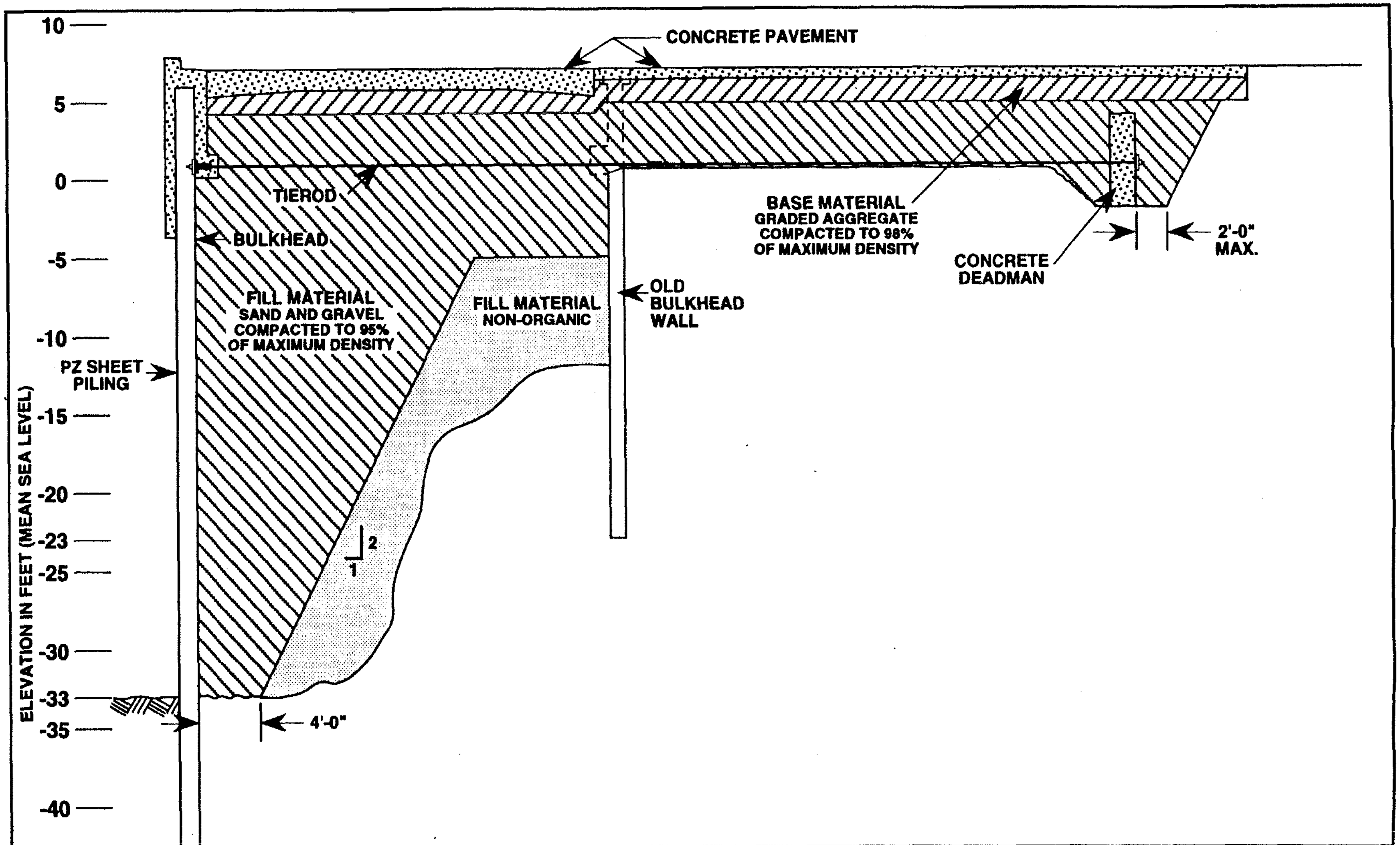

FIGURE 3-7

CROSS SECTION CONSTRUCTION DETAIL

REMEDIAL ACTION PLAN
BUILDING 103

NAVAL AIR STATION KEY WEST,
KEY WEST, FLORIDA

7519-50 940823WEM

Table 3-1
Organics Standards for Clean Soil

Remedial Action Plan
Building 103, Truman Annex
Naval Air Station Key West
Key West, Florida

Contaminant	Maximum Concentration
Total volatile organic aromatics (VOA), and 1. or 2.	100 ppb
1. Total recoverable petroleum hydrocarbons (TRPH), or	10 ppm
2. TRPH, and	50 ppm
polynuclear aromatic hydrocarbons (PAH),	1 ppm
and volatile organic halocarbons (VOH)	50 ppb

Notes: ppb = parts per billion.
ppm = parts per million.

Table 3-2
Metals Standards for Clean Soil

Remedial Action Plan
Building 103, Truman Annex
Naval Air Station Key West
Key West, Florida

Metal	Maximum Concentration	
	TCLP (mg/ℓ)	Total (mg/kg)
Arsenic	5.0	10
Barium	100.0	4,940
Cadmium	1.0	37
Chromium	5.0	50
Lead	5.0	108
Mercury	0.2	23
Selenium	V1.0	389
Silver	5.0	353

Notes: TCLP = toxicity characteristic leaching procedure.
mg/ℓ = milligrams per liter.
mg/kg = milligrams per kilogram.

product and disregards contaminated soil in other areas based on their associated risk. Explanations follow.

3.3.1 Soil Contamination Figure 3-2 illustrates the approximate areal extent of soil contamination for which remedial action is necessary. Contamination in this area, soil with OVA readings in excess of 50 ppm, is located between 3 feet bls and the water table, which is approximately 7 feet bls.

3.3.2 Free Product Free product was not observed in any site monitoring wells during the investigation conducted in 1991 or 1992. However, 1.29 feet of free product was measured in monitoring well MW-14 during the August 25, 1993, groundwater level measurement event. The presence of free product is associated with excessively contaminated soil in this area. Analytical results of samples from monitoring wells MW-4, MW-25, MW-26, MW-11, and MW-2 located in the vicinity of MW-14 indicate that the extent of free product does not extend outside the area of excessive soil contamination, which has been assessed by OVA headspace analyses. Migration of the free product further inland is unlikely due to the greater hydraulic head in that direction. The estimated extent of past or present free product corresponds with the area of soil contamination as shown on Figure 3-2.

3.4 SITE-SPECIFIC LIMITATIONS TO ALTERNATIVES. Site 103 is presently inactive and access to the site is not in question. Problems due to excessive traffic or military activity do not exist. Remedial construction or operation and maintenance activities would be acceptable in the area defined; however, subsurface features such as potable water mains, sanitary sewers, oily waste sewers, stormwater sewers, electric lines, telephone lines, fuel pipelines, and service lines exist. All of these subsurface features may restrict or limit excavation, drilling, and trenching activities at the site.

3.5 REMEDIAL STRATEGY. A remedial system should be designed to address the area of free product and the associated soil contamination. This system should have a scope that corresponds to the degree of contamination present and should complete the remedial action efficiently.

3.6 DISCUSSION OF ALTERNATIVES. After defining the contaminants of concern, the applicable cleanup standards, and the extent of contamination and developing a remedial strategy, it is necessary to identify and screen technologies that may be applicable to mitigating the contamination at the site. Because each site is unique and cleanup technologies applicable to sites contaminated with petroleum substances are continually being improved and developed, it is important to develop remedial action alternatives using the most effective technologies available.

3.6.1 Soil Remediation Generally, two possible approaches are available for soil remediation. These are *ex-situ* and *in-situ* alternatives. Descriptions follow.

3.6.1.1 *Ex-situ* Treatment *Ex-situ* treatment alternatives involve soil excavation followed by a selected treatment alternative. Five types of *ex-situ* treatment technologies that are applicable to this site are onsite incineration, thermal desorption, thermal aeration, offsite incineration, and offsite landfilling. Each of these technologies is briefly described in Table 3-3.

Table 3-3
***Ex-Situ* Soil Treatment Technologies**

Remedial Action Plan
Building 103, Truman Annex
Naval Air Station Key West
Key West, Florida

General Response Action	Soil or Sediment Technology	Description
Soil removal and disposal	Offsite landfill	Soil or sediment not regulated by RCRA land disposal restrictions is excavated and hauled to a secure, existing landfill.
Soil removal and treatment	Onsite incineration	Soil or sediment is excavated and treated by a mobile incinerator that thermally destroys organics in a direct fired treatment unit.
	Thermal aeration	Soil or sediment is excavated and treated by a mobile unit that volatilizes organic contaminants from soil or sediment and destroys them in a secondary combustion chamber.
	Thermal desorption	Soil or sediment is excavated and treated by a mobile unit that volatilizes organic contaminants from soil or sediment and condenses them into a liquid stream.
	Offsite incineration	Soil or sediment is excavated and hauled to a licensed incinerator that thermally destroys organics in a direct fired treatment unit.

Note: RCRA = Resource Conservation and Recovery Act.

3.6.1.2 *In-situ* Treatment Two types of *in-situ* treatments that may be suitable to this site are soil vapor extraction (SVE) and biological degradation or intrinsic biodegradation.

SVE systems may be used to remediate soil in the vadose zone or dewatered saturated zones. This technology generally consists of "vacuuming" gases from unsaturated soil through SVE wells with vacuum pumps. Negative pressure induced by the vacuum draws gases through the soil pore spaces. Air inlet wells combined with a surface cover may be used to facilitate the flow of atmospheric air into the soil to replace the extracted gases. Soil permeability and contaminant volatility are critical factors in the success of these systems. The extracted gases can be treated as necessary before discharge to the atmosphere. Implementation of a SVE system at Site 103 may be difficult due to the many subsurface obstructions as well as surface features such as buildings. The subsurface lithology may also make SVE difficult.

Intrinsic biodegradation or biological degradation can be accomplished if sufficient oxygen and moisture levels occur below land surface. If microorganisms are present in the vadose zone and proper conditions are met, aerobic or anaerobic degradation of the contaminant can occur. Oxygen levels in the vadose zone are sometimes controlled to maximize the degrading capacity of the microorganisms.

3.6.2 Free Product Removal A free product removal system is needed. Such a system might include a product recovery well and a product-only pumping system, which removes the free product without pumping any groundwater, or a total fluids system, which removes free product and groundwater together. Because groundwater remediation is not needed, groundwater pumping should be avoided. Direct excavation to a depth below the water table of the area where free product was detected is also an option.

Another option where only small amounts of product are present is monthly monitoring and free product recovery by manual methods when necessary. Such a program could be modified for more or less frequent product recovery as needed. This option would assure that any free product present would be dealt with, but would not be expensive to implement.

3.7 ALTERNATIVE SELECTION. The remedial action taken at Site 103 should take into account the existing site-specific considerations and conditions. In this section alternatives will be considered and an appropriate selection will be made.

3.7.1 Free Product Removal Free product thickness measured at this site represents the apparent free product thickness. Calculations are presented in Appendix C that indicate actual free product thickness to be 4 times less than the apparent product thickness. Based on this estimate, free product recovery as a separate remedial phase is not practical. Therefore, free product removal should be integrated into the soil remedial phase.

3.7.2 Soil Remediation The area of soil contamination near the abandoned aboveground tank pad is associated with the free product detected in MW-14. Using an *ex-situ* alternative for this area could combine soil remedial efforts with free product removal. In this area, excavation to a depth of approximately 1 foot below the water table is recommended for the contaminated area contained within the 50 ppm isoconcentration line.

The *ex-situ* onsite treatment alternatives mentioned are not considered feasible as the amount of soil (540 cubic yards [yd^3]) to be excavated does not warrant the mobilization of equipment and manpower to treat it. For this reason these options are eliminated from further consideration.

An offsite alternative is suggested, due to the small amount of soil to be remediated. In case of incineration, the offsite facility chosen must operate in accordance with Chapter 17-775, FAC, and meet the general permit requirements in Chapters 17-4.510 through 17-4.540, FAC. This method is also preferred due to the complete destruction of the contaminants involved.

Finally, landfilling the contaminated soil is not viable, due to the presence of free product in the proposed area to be excavated. Efforts to retrieve free product may lead to excavation into the upper layers of the saturated zone, which would make landfilling an unsuitable option.

3.7.3 Conclusion Due to the small amount of free product present, an integration of product removal and soil remediation is recommended. The area of soil contamination associated with the free product area should be treated *ex-situ* with offsite incineration, and excavation should be conducted in an effort to capture any free product contained in the capillary fringe.

4.0 RECOMMENDED REMEDIAL ACTION

The recommended remedial action for Site 103 consists of source abatement through excavation and free product removal. Contaminated soil associated with the zone of free product will be excavated and treated. Provisions should be provided for free product recovery from the excavation if necessary. The remedial system layout as well as the area to be excavated are shown in Figure 4-1. Although the potential discharge of contaminated groundwater into the turning basin is considered a principal threat, the bulkhead, tidal action, and the natural gradient will tend to contain the plume. Remedial action for the groundwater at Site 103 is not recommended at this time.

4.1 SOIL EXCAVATION AND TREATMENT. The area of excavation shown in Figure 4-1 is approximately 3,000 square feet (ft^2). The soil is classified as clayey sands (SC) to silty sands (SM) based on the Unified Soil Classification System (USCS).

Excavation and thermal treatment processes should be performed as outlined in Chapter 17-775, FAC. Excavation to a depth of 7 feet bls is proposed for the area shown in Figure 4-1. The total volume of soil to be excavated is 940 yd^3. The upper three feet of soil is not excessively contaminated. The volume associated with contaminated soil is approximately 540 cubic yards. Soil volume calculations include a swell factor of 12 percent and are presented in Appendix C, Engineering Calculations.

4.1.1 Pretreatment Sampling. The area of soil contamination corresponds with the suspected area of free product contamination. Based on the volume of contaminated soil expected, five composite pretreatment samples must be analyzed as described in Table 4-1 for VOAs, TRPHs, and volatile organic halocarbons in accordance with Chapter 17-775.410, FAC. A total metals analysis must also be performed. Each composite soil sample must be collected from at least four locations in the contaminated area and can be taken while performing the excavation.

4.1.2 Excavation Excavation will be conducted using standard earthmoving equipment. All operators will be certified by the Occupational Safety and Health Administration. Excavated soil from the top 3 feet, approximately 400 yd^3, is not contaminated and will be stockpiled onsite in the designated area. OVA headspace analyses will be performed at set intervals during the excavation to monitor soil contaminant levels. When excessive soil contamination (OVA readings in excess of 50 ppm) is reached, excavation of contaminated soil will continue horizontally to the circumference where contaminant concentrations are below 50 ppm on the OVA. Excavation to a depth approximately 1 foot below groundwater may be necessary to implement free product removal. Excavated soil that is contaminated should be loaded directly into trucks to facilitate immediate site removal and delivery to a permitted soil thermal treatment facility and to prevent spreading of the contaminated soil at the site. A listing of permitted thermal treatment facilities is provided in Appendix D.

The excavation should have sides sloped or shored in accordance with applicable standards to prevent unstable conditions during excavation that could pose hazards to personnel or surrounding structures and pavements. Stormwater runon and runoff controls should be implemented to prevent offsite migration of sediment or

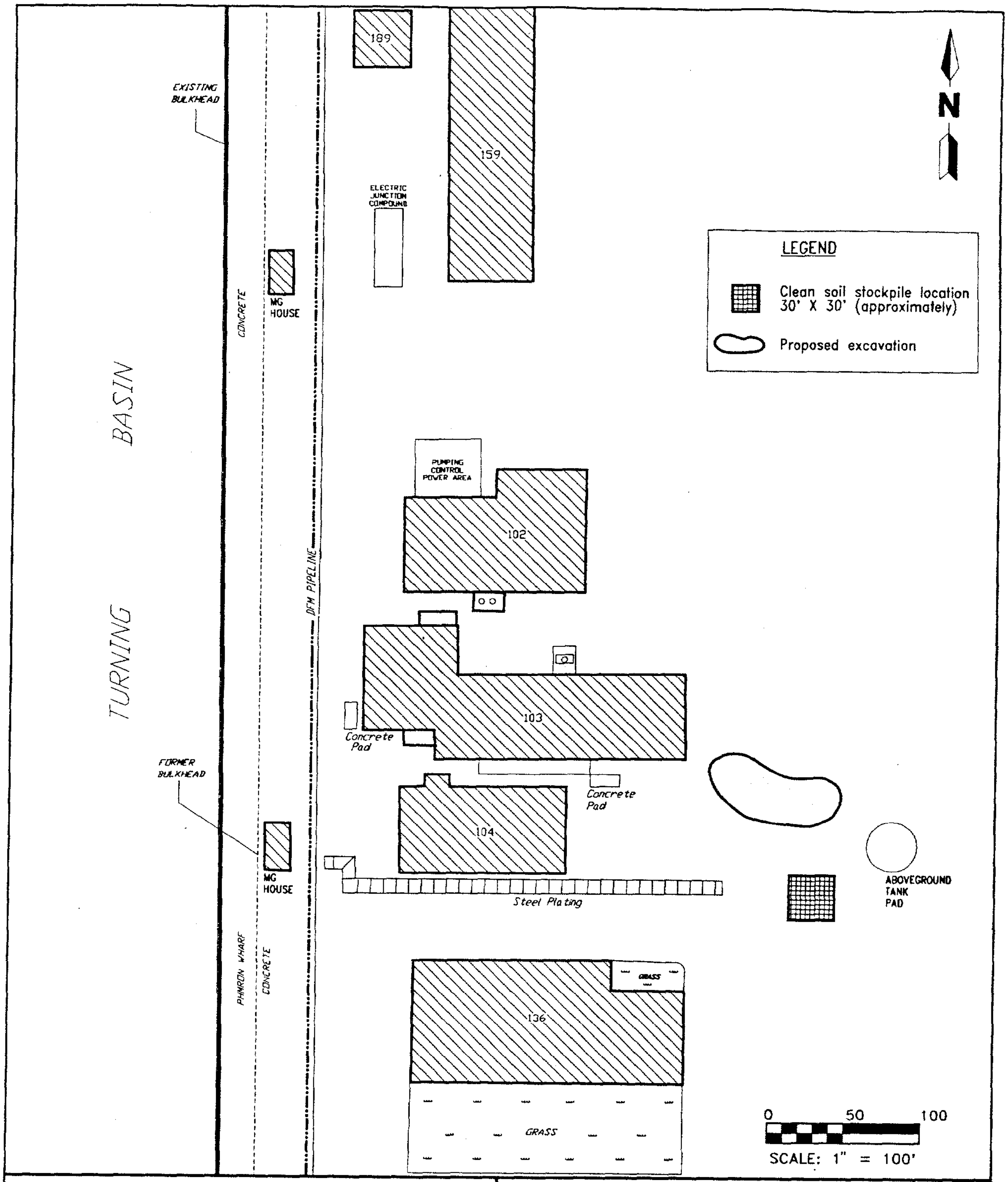

FIGURE 4-1
REMEDIAL SYSTEM LAYOUT

KEYWEST\BLDG-103\WDW\08-24-94

REMEDIAL ACTION PLAN
BUILDING 103

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

Table 4-1
Soil Sampling and Analyses

Remedial Action Plan
Building 103, Truman Annex
Naval Air Station Key West
Key West, Florida

Contaminant	Test Method
Total volatile organic aromatics (VOA)	USEPA Methods 5030/8020
Total recoverable petroleum halocarbons	USEPA Draft Method 9073
Polynuclear aromatic hydrocarbons (PAH)	USEPA Methods 3540/8100, 3550/8100, 3540/8250, 3540/8270, 3550/8250, 3550/8270, 3540/8310, or 3550/8320
Volatile organic halocarbons (VOH)	USEPA Method 5030/8010
Metals	
Arsenic	USEPA Methods 7060, 7061, or 6010
Barium	USEPA Method 7080 or 6010
Cadmium	USEPA Method 7130, 7131, or 6010
Chromium	USEPA Method 7190, 7191, or 6010
Lead	USEPA Method 7420, 7421, or 6010
Mercury	USEPA Method 7471
Selenium	USEPA Method 7040, 7041, or 6010
Silver	USEPA Method 7760 or 6010

Source: Chapter 17-775.400(4) through 17-775-410(1)(e), Florida Administrative Code.

Note: USEPA = U.S. Environmental Protection Agency.

contaminated stormwater during site activities. Dust control should also be implemented to prevent fugitive emissions during excavation and soil handling. Benchmarks, existing structures, fences, sidewalks, utilities, and other cultural features shall be protected from excavation equipment. A professional survey to verify locations of site utilities was not conducted for this report; however, active or inactive subsurface obstructions are believed to be present. Obstructions may include piping for sanitary sewerage, gas distribution, storm drainage and/or fresh and salt water distribution. Subsurface features should be field verified prior to excavating.

4.2 FREE PRODUCT REMOVAL. The approximate volume of free product associated with the area to be excavated is 1,650 gallons. Excavation below the depth of the water table will be required to capture free product that is entrained in the capillary fringe. This may cause an infiltration of the surrounding groundwater into the open area. If free product is detected in recharging groundwater, recovery will be necessary. The volume of any infiltrating free product is unknown; however, because it would be originating from outside the expected area of free product, small quantities, if any, are expected. A tanker-truck with vacuum connections or another equivalent method of product removal will be available onsite in the event that free product infiltration is detected.

4.3 SITE RESTORATION AND DEMOBILIZATION. All water from the excavation during soil replacement should be removed as necessary to accommodate compaction. Upon completion of the excavation, the stockpiled soil and backfill materials will be blended to a uniform consistency when placed in the excavation and field compacted in place to surrounding conditions with earthmoving equipment tracks to a minimum of 85 percent Proctor (American Society for Testing and Materials [ASTM] D1557) or approved equal. Backfill material will be compacted in lifts of approximately 1 foot. Compactive effort will be no less than four passes of the earthmoving equipment. Approximately 560 yd^3 of backfill material will be needed.

The excavation will be raised grade to above surrounding elevations and the grade will be sloped from the center outward to a minimum slope of 50 horizontal to 1 vertical so that runoff will flow away from the backfilled area. The slope will be blended into level areas and the grade changes will be gradual. Common fill compatible with surrounding soils can be used if additional backfill materials are needed to obtain slopes. Certification that the common fill is free of petroleum hydrocarbon contamination is required from the backfill source prior to delivery.

During backfill operations, utility services will be disconnected in coordination with base personnel. After completion, benchmarks, existing structures, fences, sidewalks, utilities, and other cultural features to remain that were damaged during remedial activities will be repaired. All lines and grades will be verified after all equipment and materials have been removed from the site and work is complete. Final review of project documentation as well as a walk over of the site will be conducted to assure satisfactory completion of the project prior to leaving the site.

5.0 COST ESTIMATE

The cost estimate is inserted following Appendix E in those report copies that require it and has been omitted in others. This was done to facilitate Navy procurement requirements.

6.0 SCHEDULE

The total cleanup time involved will constitute approximately 1.5 week.

- It is estimated that 1 day will be necessary for pretreatment sampling allowing for 1 week turnaround time for laboratory analyses and report preparation.
- Mobilization of equipment and field crew for the actual excavation will take 1 day.
- The soil removal will take approximately 3 days for excavation, transport, and treatment.
- Time for compaction and backfill is estimated to be 2 days.
- Site restoration will take 1 day.
- Standby time such as time spent removing water or free product or time spent during onsite analyses will constitute 1 day of excavation time.

7.0 DOCUMENTATION

An operation and maintenance (O&M) manual should be provided at the time of excavation. The manual should provide all necessary information for the proper operation and maintenance of the operation by someone other than the Remedial Action Contractor (RAC). The O&M manual should include, at a minimum, the following:

- log of OVA readings and pretreatment sampling locations and laboratory analytical results,
- a map of the excavated area including locations of utilities and obstructions,
- Material Safety Data Sheets for materials used or being treated,
- manifests and documentation of treatment and disposal, and
- instructions for maintaining a site activity log.

The manual should be assembled and bound in a manner suitable for use in the field.

8.0 PROFESSIONAL REVIEW CERTIFICATION

This RAP was prepared using standard engineering practices and designs. The plan for remediating this site is based on the information collected between August 1991 and August 1993 and engineering detailed in the text and appended to this report. If conditions are determined to exist differently than those described, the undersigned professional engineer should be notified to evaluate the effects of any additional information on the design described in this report.

This RAP was developed for Site 103, Truman Annex, NAS Key West, Florida, and should not be construed to apply to any other site.

Michael K. Dunaway
P.E. No. 39451
Principal Engineer

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APPENDIX A

ANALYTICAL RESULTS

Table A-1
Summary of Soil Sample Organic Vapor Analyzer (OVA) Headspace Analyses, March 23 through March 26, 1993

Remedial Action Plan
Building 103, Truman Annex
Naval Air Station Key West
Key West, Florida

Soil Boring Number	Depth Below Land Surface (feet)	OVA Headspace/TRPH Reading (ppm)
SB-25	0.0 to 1.0	1
	1.0 to 3.0	<1
	3.0 to 5.0	460
	5.0 to 7.0	80
SB-26	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	2
SB-27	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
	5.0 to 7.0	10
SB-28	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-29	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-30	0.0 to 1.0	<1
	1.0 to 3.0	2
	3.0 to 5.0	<1
SB-31	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-32	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-33	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	2

See notes at end of table.

Table A-1 (Continued)
Summary of Soil Sample Organic Vapor Analyzer (OVA) Headspace Analyses, March 23 through March 26, 1993

Remedial Action Plan
Building 103, Truman Annex
Naval Air Station Key West
Key West, Florida

Soil Boring Number	Depth Below Land Surface (feet)	OVA Headspace/TRPH Reading (ppm)
SB-25	0.0 to 1.0	1
	1.0 to 3.0	<1
	3.0 to 5.0	460
	5.0 to 7.0	80
SB-26	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	2
SB-27	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
	5.0 to 7.0	10
SB-28	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-29	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-30	0.0 to 1.0	<1
	1.0 to 3.0	2
	3.0 to 5.0	<1
SB-31	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-32	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-33	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	2

See notes at end of table.

Table A-1 (Continued)
Summary of Soil Sample Organic Vapor Analyzer (OVA) Headspace Analyses, March 23 through March 26, 1993

Remedial Action Plan
Building 103, Truman Annex
Naval Air Station Key West
Key West, Florida

Soil Boring Number	Depth Below Land Surface (feet)	OVA Headspace/TRPH Reading (ppm)
SB-34	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-35	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-36	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-37	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-38	0.0 to 1.0	5
	1.0 to 3.0	3
	3.0 to 5.0	2
SB-39	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-40	0.0 to 1.0	NS
	1.0 to 3.0	NS
	3.0 to 5.0	NS
SB-41	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	9
SB-42	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	1
SB-43	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	30

See notes at end of table.

Table A-1 (Continued)
Summary of Soil Sample Organic Vapor Analyzer (OVA) Headspace Analyses, March 23 through March 26, 1993

Remedial Action Plan
Building 103, Truman Annex
Naval Air Station Key West
Key West, Florida

Soil Boring Number	Depth Below Land Surface (feet)	OVA Headspace/TRPH Reading (ppm)
SB-44	0.0 to 1.0	90
	1.0 to 3.0	30
	3.0 to 5.0	20
SB-45	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-46	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-47	0.0 to 1.0	<1
	1.0 to 3.0	1
	3.0 to 5.0	<1
SB-48	0.0 to 1.0	2
	1.0 to 3.0	7
	3.0 to 5.0	23
SB-49	0.0 to 1.0	18
	1.0 to 3.0	12
	3.0 to 5.0	121
SB-50	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-51	0.0 to 1.0	1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-52	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	50
SB-53	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	35

See notes at end of table.

Table A-1 (Continued)
Summary of Soil Sample Organic Vapor Analyzer (OVA) Headspace Analyses, March 23 through March 26, 1993

Remedial Action Plan
Building 103, Truman Annex
Naval Air Station Key West
Key West, Florida

Soil Boring Number	Depth Below Land Surface (feet)	OVA Headspace/TRPH Reading (ppm)
SB-54	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	4
SB-55	0.0 to 1.0	1
	1.0 to 3.0	<1
	3.0 to 5.0	13
SB-56	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	13
SB-57	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	26
SB-58	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-59	0.0 to 1.0	<1
	1.0 to 3.0	1
	3.0 to 5.0	3
SB-60	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-61	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-62	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	NS
SB-63	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	NM

See notes at end of table.

Table A-1 (Continued)
Summary of Soil Sample Organic Vapor Analyzer (OVA) Headspace Analyses, March 23 through March 26, 1993

Remedial Action Plan
Building 103, Truman Annex
Naval Air Station Key West
Key West, Florida

Soil Boring Number	Depth Below Land Surface (feet)	OVA Headspace/TRPH Reading (ppm)
SB-64	0.0 to 1.0	<1
	1.0 to 3.0	1
	3.0 to 5.0	79
SB-65	0.0 to 1.0	<1
	1.0 to 3.0	3
	3.0 to 5.0	7
SB-66	0.0 to 1.0	2
	1.0 to 3.0	<1
	3.0 to 5.0	<1
SB-67	0.0 to 1.0	<1
	1.0 to 3.0	<1
	3.0 to 5.0	8
SB-68	0.0 to 1.0	<1
	1.0 to 3.0	4
	3.0 to 5.0	3
SB-69	–	NM

Notes: ppm = parts per million.
NS = not sampled.
NM = not measured.

APPENDIX B

CORRESPONDENCE

ABB ENVIRONMENTAL SERVICES, INC.
ASEA BROWN BOVERI

A NAVY CLEAN Underground Storage Tank Department

MEMORANDUM

TO: **Gabriel Magwood**
SOUTHDIV
NAVFACENGCOM

FROM: Mark C. Diblin, P.G. MCD
TOM, UST Dept.

DATE: July 12, 1994

SUBJECT: Site 103 RAP/Risk Assessment Meeting Minutes of 1 July 1994

Meeting Attendees:

Jorge Caspary (FDEP)	Mark Diblin (ABB)	Gabriel Magwood
Tim Larson (FDEP)	Mike Dunaway (ABB)	(SOUTHDIV)
	Joe Ullo (ABB)	(via telephone)
	Marland Dulaney (ABB)	

Purpose:

To determine the appropriate course of action to be employed at NAS Key West, Site 103, with regard to the Remedial Action Plan (RAP) and the associated Risk Assessment (RA).

Summary:

Mike Dunaway outlined ABB's present course of action which included:

I. A Site Background review with CAR and CARA results.

A. Facility location and site layout (Attachments 1 & 2)
B. Contamination distribution maps (Attachments 3 - 6)
C. Water table elevation data (Attachments 7 & 8)
D. Bulkhead cross-section (Attachment 9)
E. Petroleum fingerprints, USEPA Method 3550/8100 (Attachment 10)

II. A review of the present remedial approach.

A. Assumption of bulkhead as an impermeable layer thereby restricting contaminant transport into the turning basin
B. Soil not a continuing source of groundwater contamination as shown by contamination distribution maps

C. Estimation of the contamination present as closely resembling # 4 fuel oil (diesel fuel marine) as shown by fingerprints

D. Concern about the free product detected in MW-14 during sampling in August of 1993.

Marland Dulaney then gave an overview of the methodology to be employed in performing the risk assessment and calculating Risk-Based Alternative Site Rehabilitation Levels (ASRLs). Equations used and exposure scenarios are shown in Attachment 11.

Comments and suggestions were then given by Tim Larson and Jorge Caspary.

I. In regard to ABB's present remedial approach:

A. Assumption of bulkhead as an impermeable barrier protecting the surface water in the turning basin from the contaminated groundwater will need to be supported

B. Petroleum fingerprints - Tim Larson suggested that the actual~~ly~~ fuel present resembles a combination of #4 fuel oil and diesel. In either case, the estimate is conservative.

C. Free product in MW-14

1. Product must be addressed with free product recovery
2. Possible dewatering and excavation in the area surrounding MW-14 to remove contaminated soil to the 50 ppm isoconcentration line

D. FDEP personnel agreed that, except in the area of monitoring well MW-14, soil contamination and groundwater contamination did not correlate to one another. This was determined by comparing the soil contaminant maps with the groundwater contaminant maps [Attachments 3 (soil) and 4, 5, & 6 (groundwater)].

II. In regard to ABB's calculations and assumptions for ASRLs:

A. Agreed that assumptions would be appropriate, however, they were going to check with the FDEP risk assessor, Lehia Mora-Applegate

B. Recommended that the soil analysis be checked to find the average depth of contamination

C. Checked the Particulate Emission Factor (PEF) used in the calculations for consistency with their own

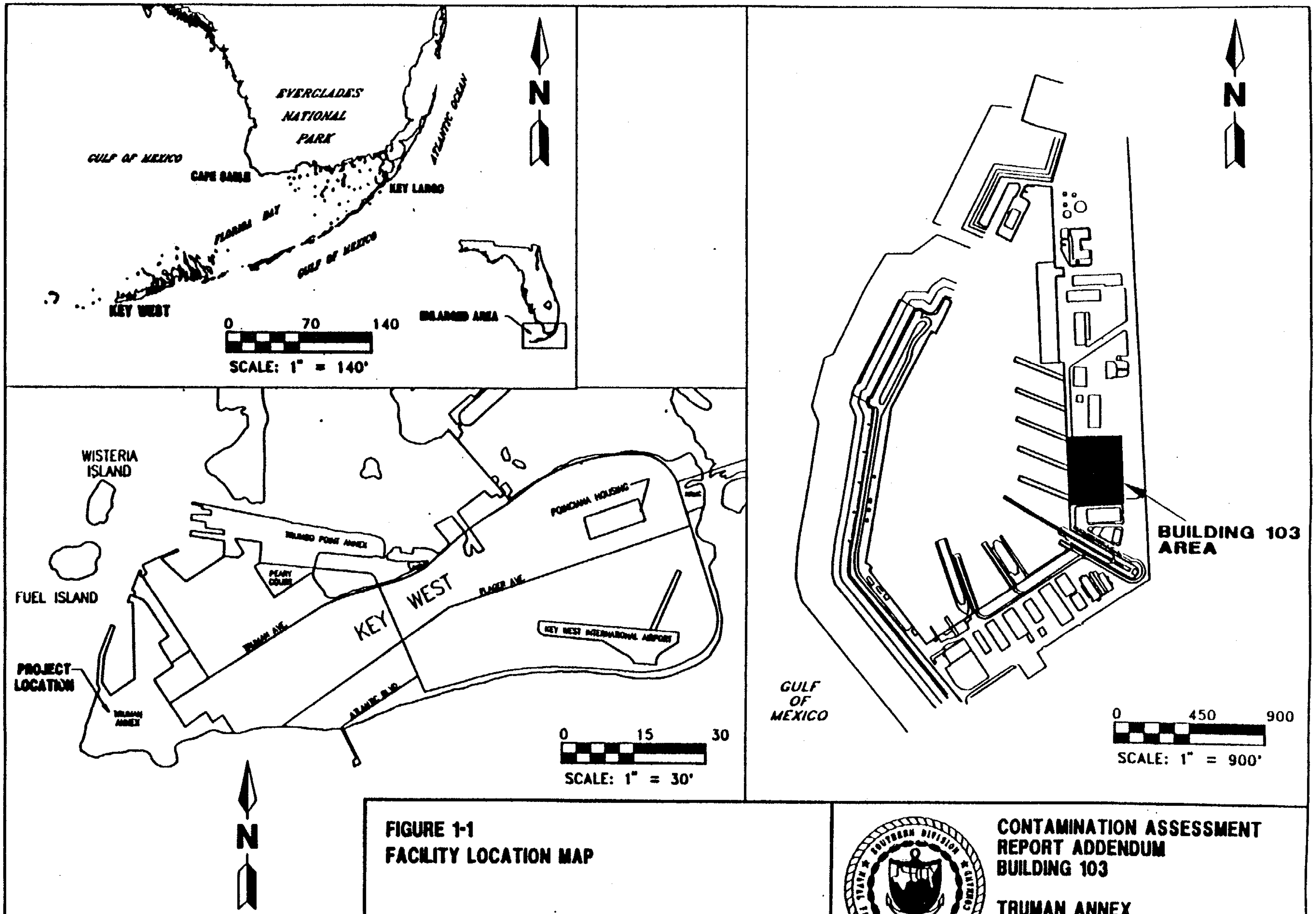
D. Requested that a RA be done for a residential scenario because a deed restriction would be required for future construction if industrial scenario were used.

Below is a list of recommendation and **action items** as a result of the meeting.

1. Confirmation soil sampling from three locations at the site (as shown in Attachment 12) for analysis of PAH and TRPH by USEPA methods 8100 and 8310
2. The RAP must present supporting data that all pathways for potential receptors of contamination have been eliminated.
3. The RAP must provide backup documentation to support the theory that the dock bulkhead is impermeable.
4. The RAP should contain recommendations for soil and product removal in the vicinity of monitoring well MW-14.
5. Marland Dulaney will contact Lehia Mora-Applegate to discuss the RA with her and any specific items she may require.
6. The RA should look at and consider the following three exposure pathways: soil residential, soil construction worker, and nonpotable groundwater usage. Because one of the most likely future land uses is condominium, the resident exposure scenario will be required. We would need a deed restriction if we only used the industrial numbers and it is not likely we could get a deed restriction.
7. Mark Diblin mentioned the high mobilization costs for ABB associated with the recommended soil sampling in Key West. Bill Hunt, the BEC (Base Environmental Coordinator) at NAS Key West, will be contacted by Gabriel Magwood concerning the possibility of his group or a subcontractor handling any additional assessment work (i.e. soil sampling). Also, the product level in monitoring well MW-14 should be checked by whoever visits the site.
8. ABB-ES will look into the data collected during the CA to see if sufficient soil contamination data exist for the soils in each boring between the surface and 3 feet below land surface. This data may be sufficient to forego any further soil sampling.

Distribution: Jorge Caspary, FDEP Tim Larson, FDEP Lehia Mora-Applegate, FDEP Mike Dunaway, ABB-ES Maralnd Dulaney, ABB-ES Joe Ullo, ABB-ES John Kaiser, ABB-ES Mark Diblin, ABB-ES Gabriel Magwood, SOUTHDIV

File: users\ust\cto007\site103\rap\minutes.



LOCMAP/MP/8-27-93

FIGURE 1-1
FACILITY LOCATION MAP

ATTACHMENT 1

CONTAMINATION ASSESSMENT REPORT ADDENDUM
BUILDING 103

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

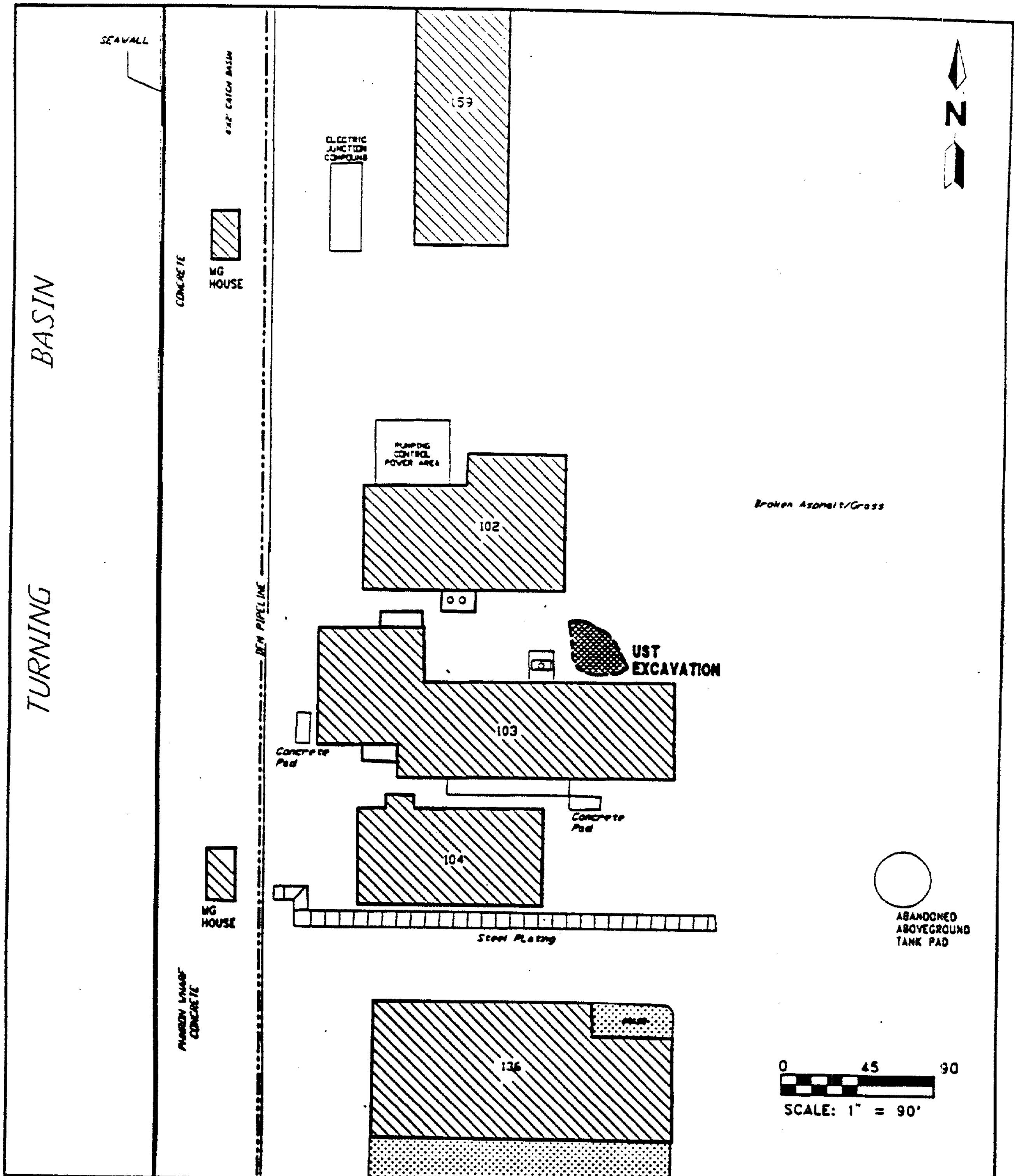


FIGURE 2-1
SITE PLAN

ATTACHMENT 2

CONTAMINATION ASSESSMENT REPORT ADDENDUM
BUILDING 103

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

CAR-ADD/NP/9-20-93

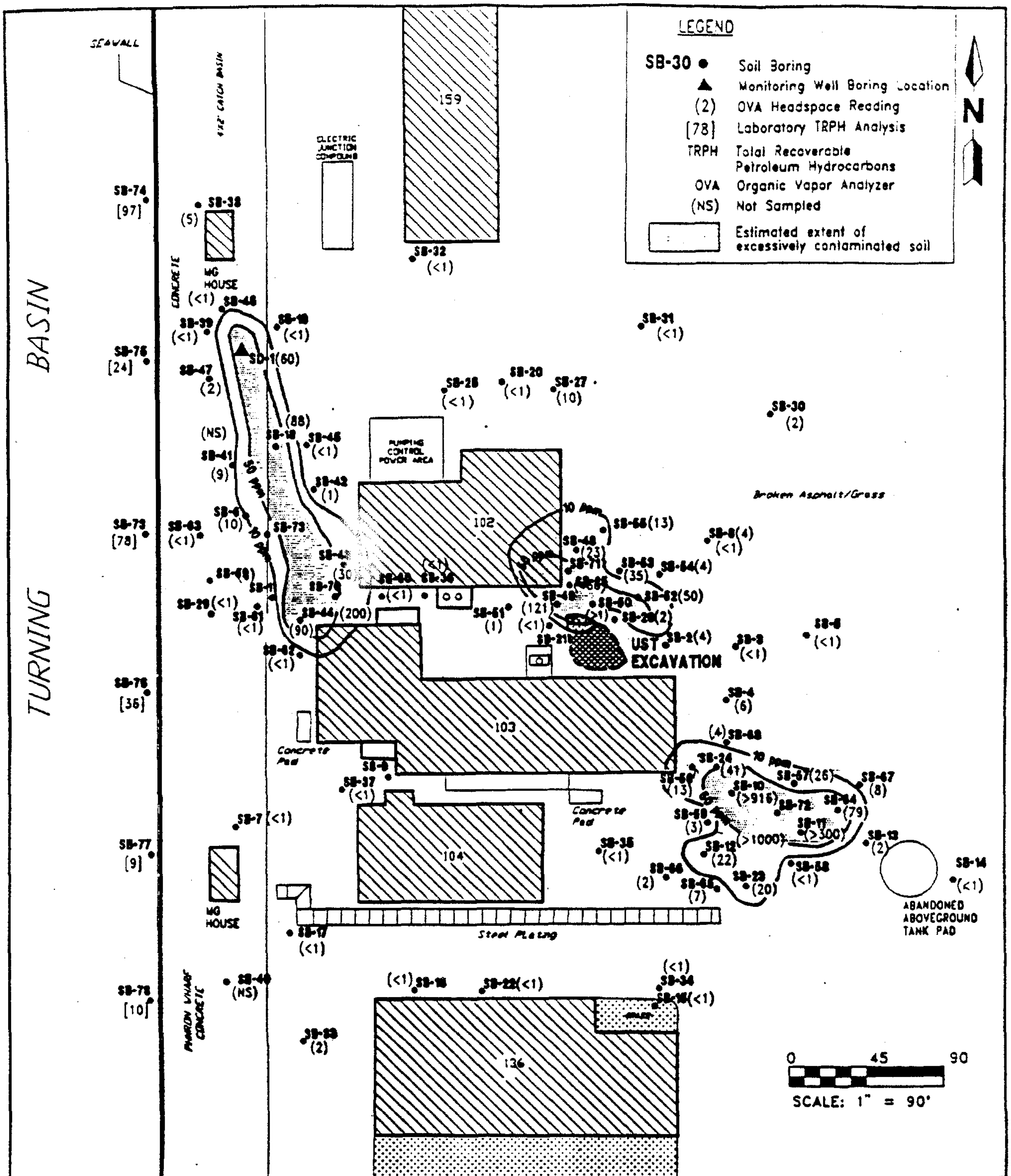


FIGURE 4-1
SOIL CONTAMINATION DISTRIBUTION MAP

ATTACHMENT 3

CONTAMINATION ASSESSMENT REPORT ADDENDUM
BUILDING 103
TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

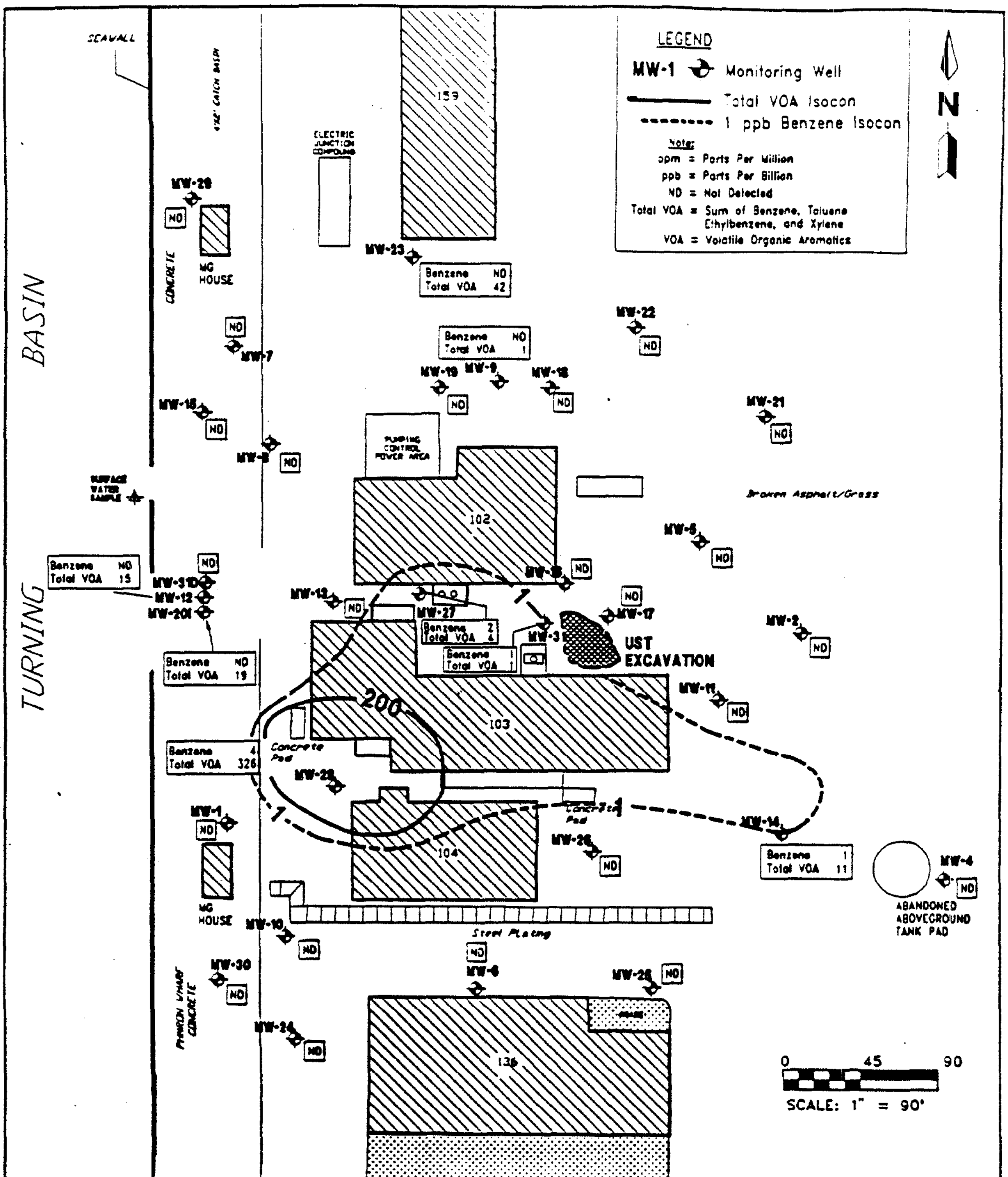


FIGURE 4-4
BENZENE AND TOTAL VOA GROUNDWATER CONTAMINATION DISTRIBUTION MAP
MARCH 28, 29, AND 30, 1993 AND JUNE 10, 1993

ATTACHMENT 4

CONTAMINATION ASSESSMENT REPORT ADDENDUM
BUILDING 103,
TRUMAN ANNEX

NAVAL AIR STATION
KEY WEST, FLORIDA

CAR-ADD/KGP/09/21/93/vpifig3-9

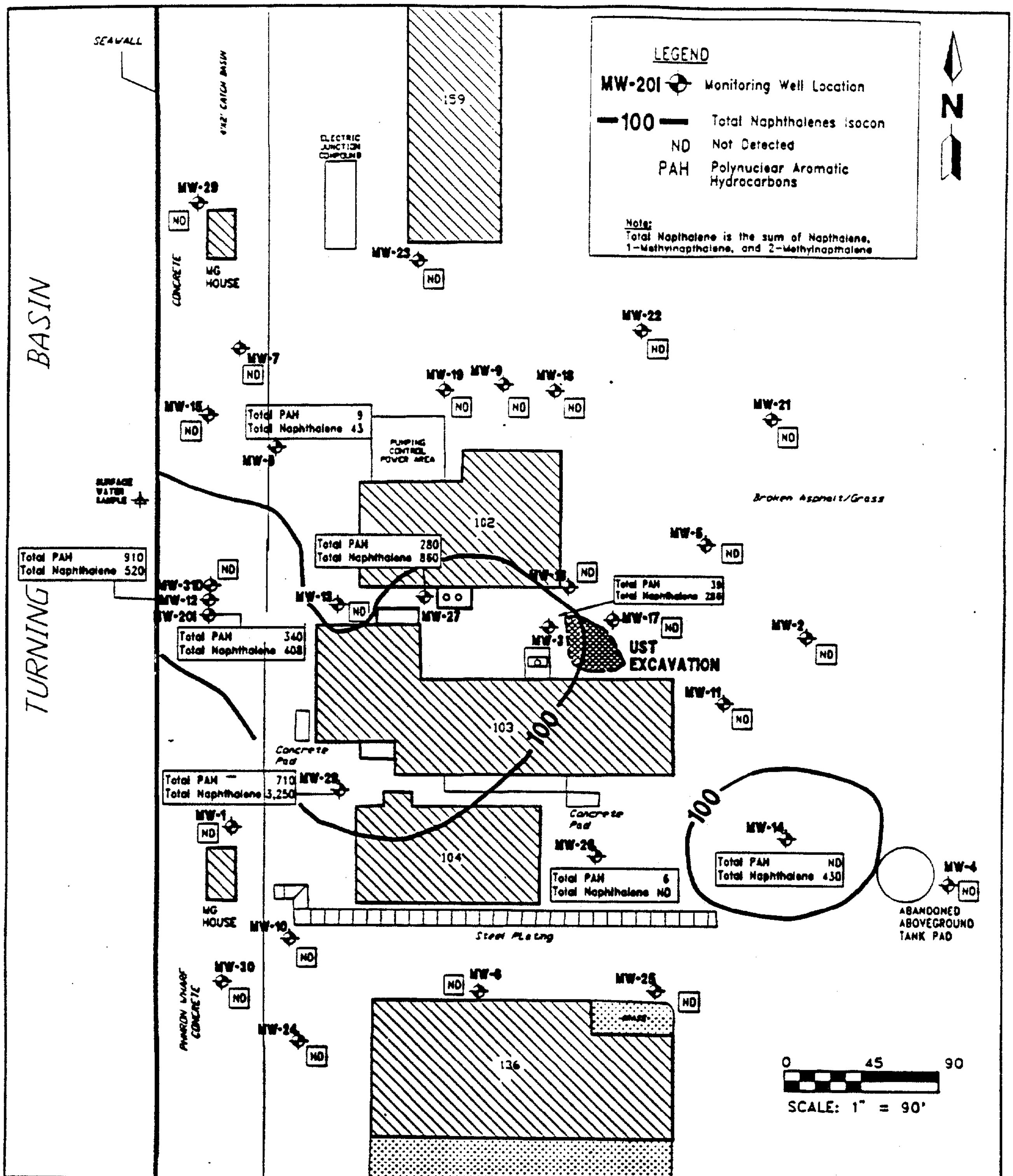


FIGURE 4-5
TOTAL PAH AND TOTAL NAPHTHALENE GROUNDWATER CONTAMINATION DISTRIBUTION MAP MARCH 28, 29, AND 30, 1993 AND JUNE 10, 1993

ATTACHMENT 5

CONTAMINATION ASSESSMENT REPORT ADDENDUM BUILDING 103, TRUMAN ANNEX

NAVAL AIR STATION KEY WEST, FLORIDA

CAR-ADD/KCP/09/20/93/vpifig3-10

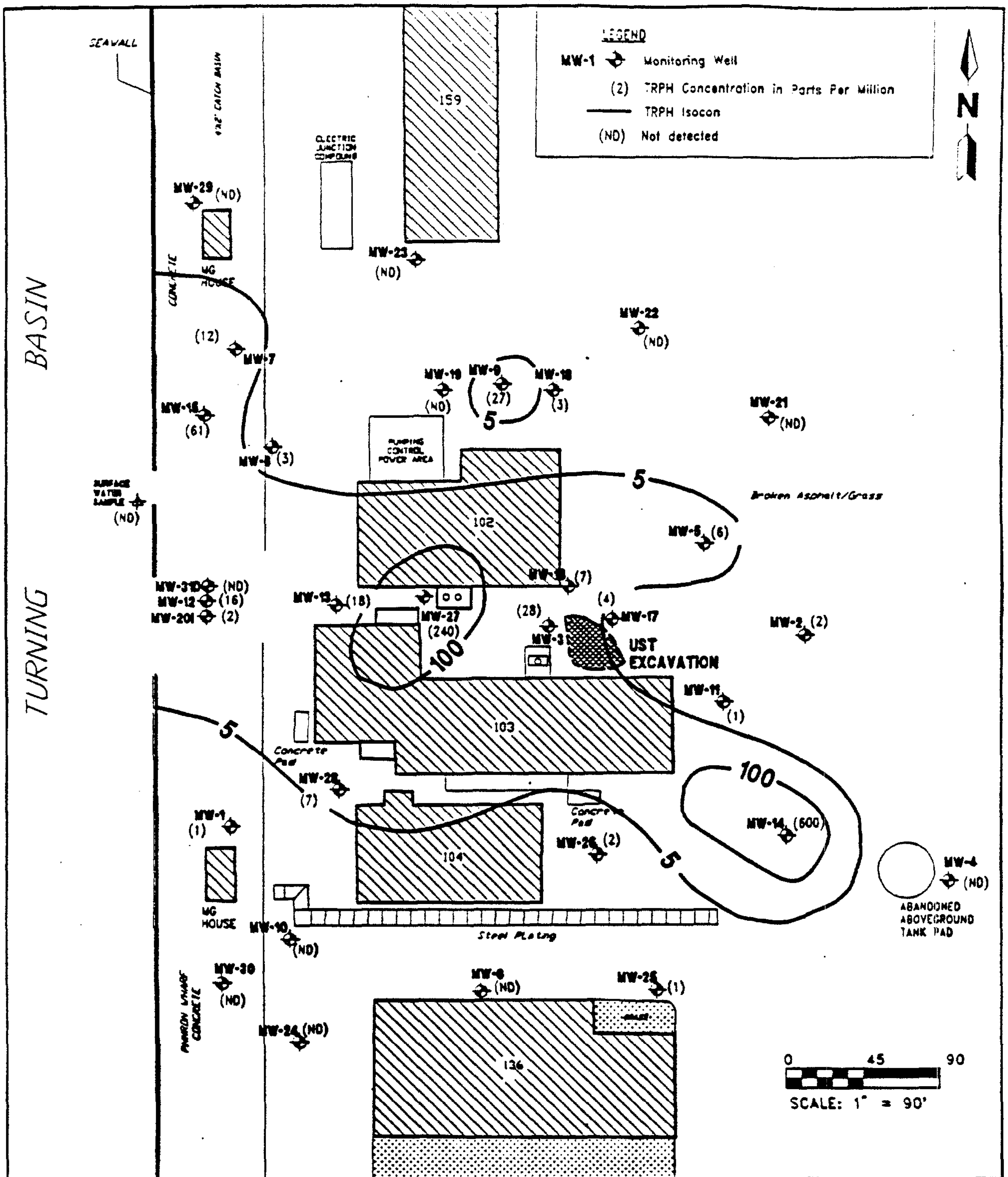


FIGURE 4-6
TRPH GROUNDWATER CONTAMINATION DISTRIBUTION MAP
MARCH 28, 29, AND 30, 1993 AND JUNE 10, 1993

ATTACHMENT 6

CONTAMINATION ASSESSMENT REPORT ADDENDUM
BUILDING 103

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

CAR-ADD/KCP/09/21/93/vpifig3-11

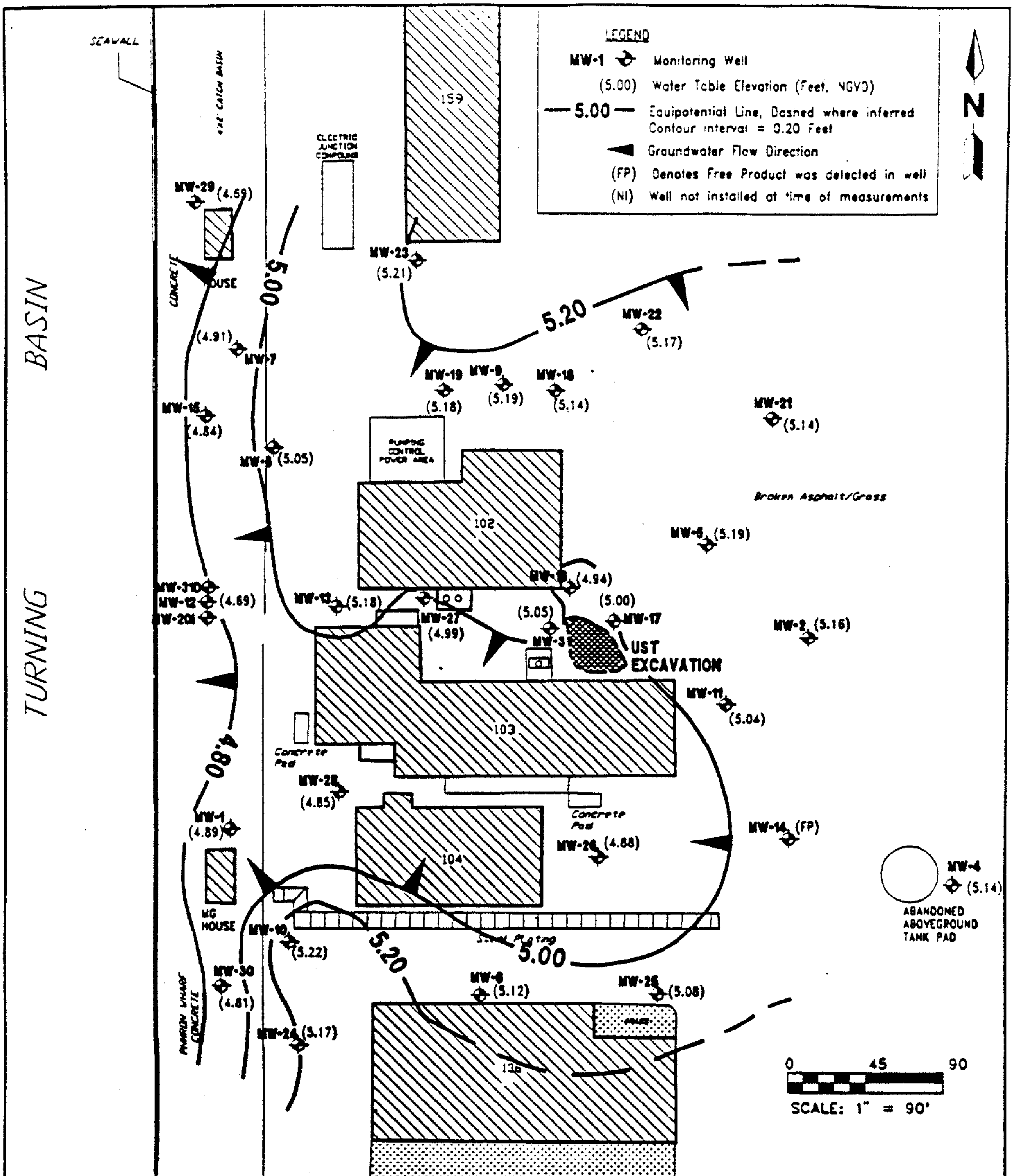


FIGURE 4-3
GROUNDWATER ELEVATION CONTOUR MAP
SURFICIAL ZONE, AUGUST 25, 1993

ATTACHMENT 7

CONTAMINATION ASSESSMENT REPORT ADDENDUM
BUILDING 103

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

CAR-ADD/KGP/09/21/93/vpfig3-8

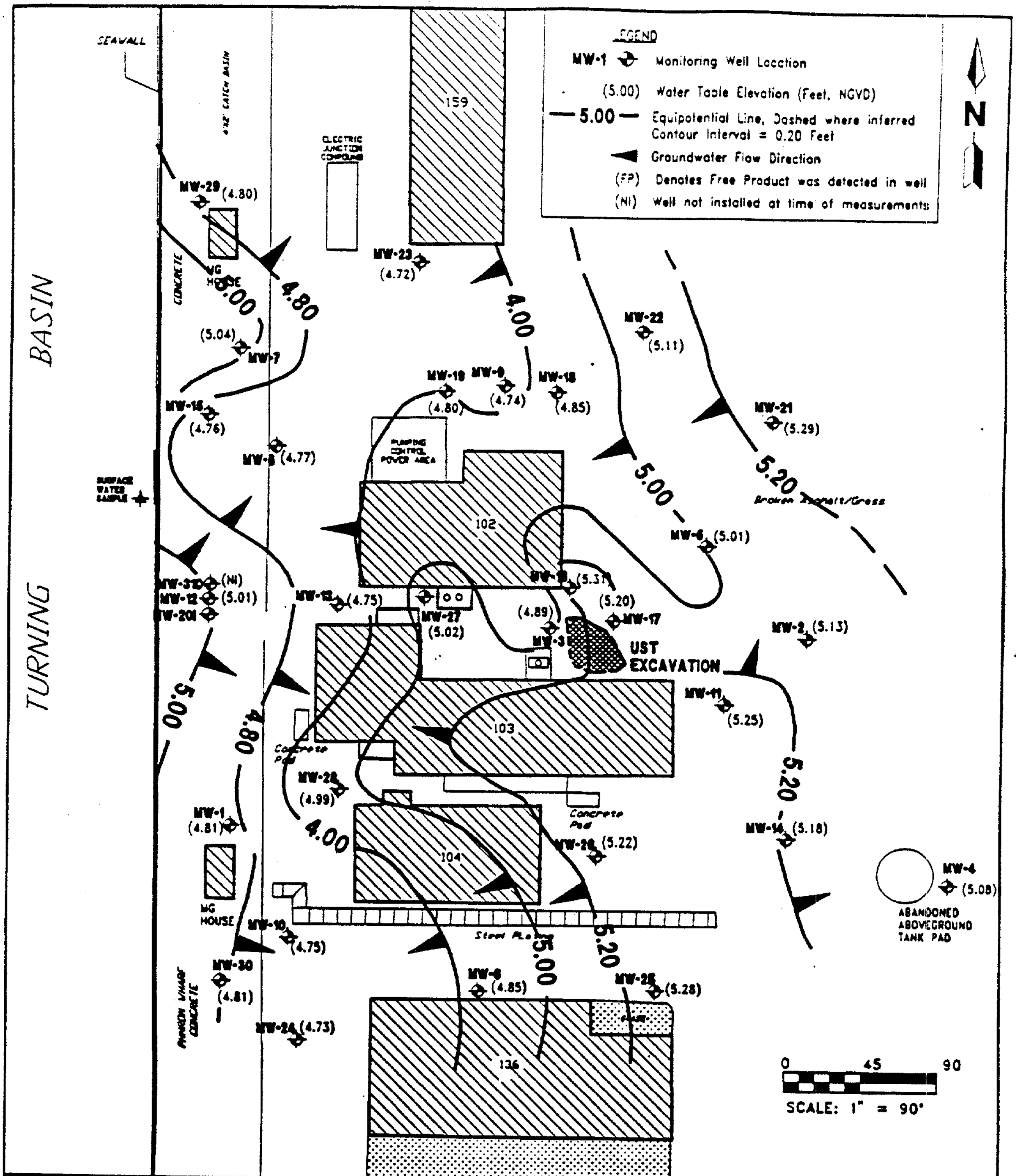


FIGURE 4-2
GROUNDWATER ELEVATION CONTOUR MAP
SURFICIAL ZONE, MARCH 28, 1993

ATTACHMENT 8

CONTAMINATION ASSESSMENT REPORT ADDENDUM
BUILDING 103

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

CAR-ADD/KGP/09/21/93/fig3-7

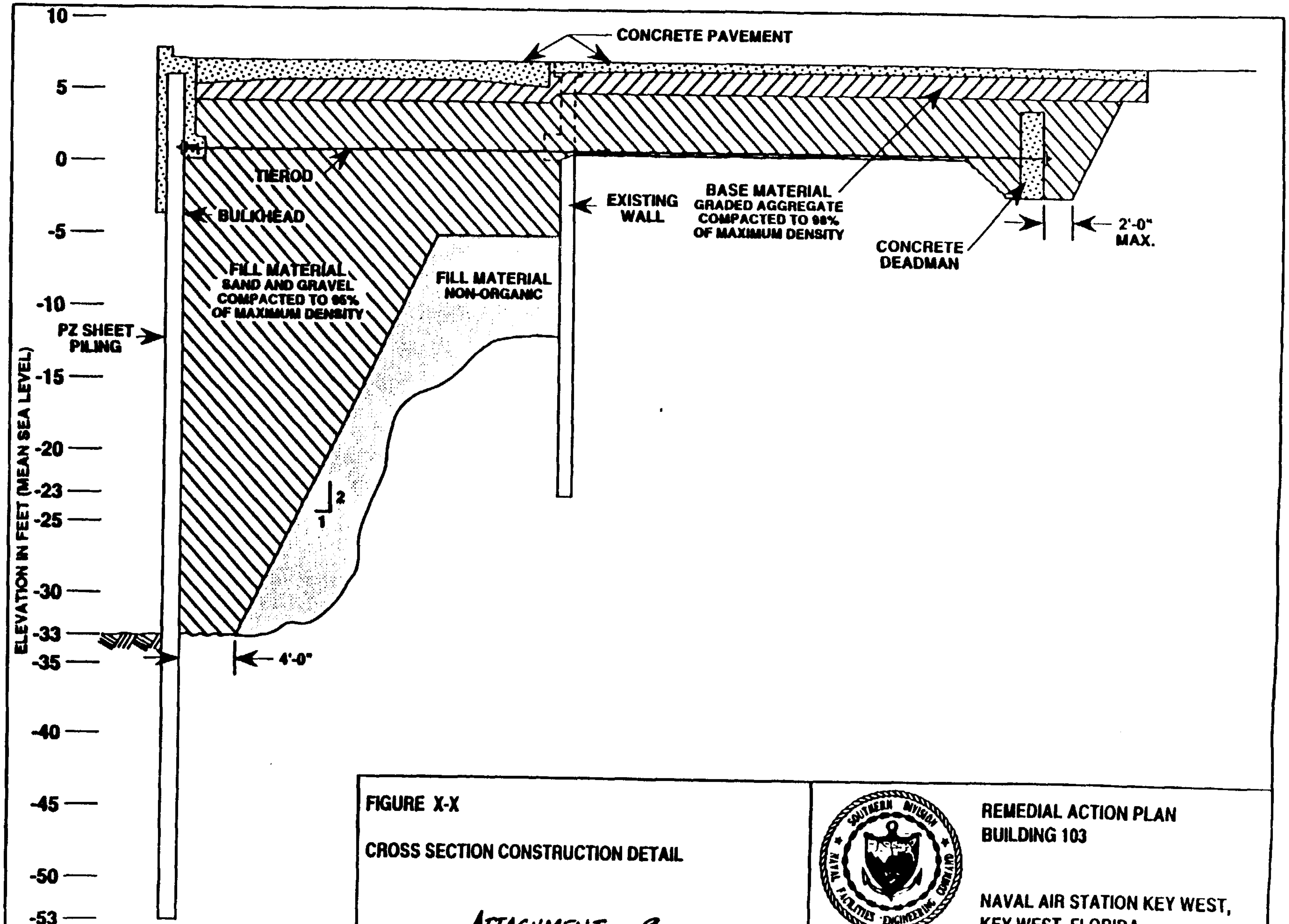


FIGURE X-X

CROSS SECTION CONSTRUCTION DETAIL

ATTACHMENT 9

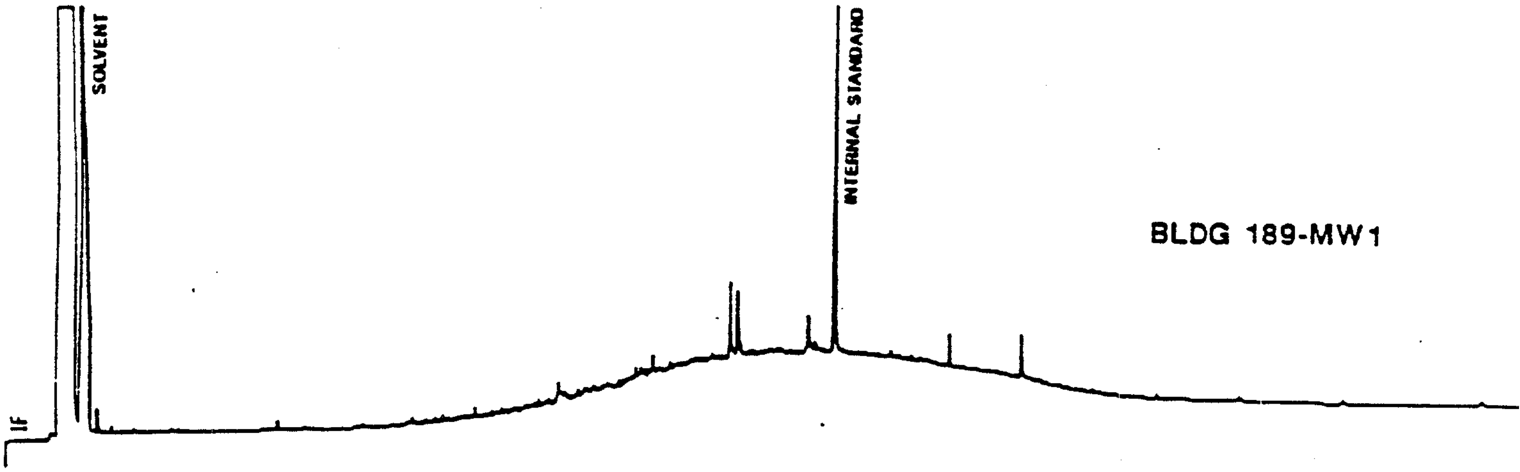
REMEDIAL ACTION PLAN
BUILDING 103

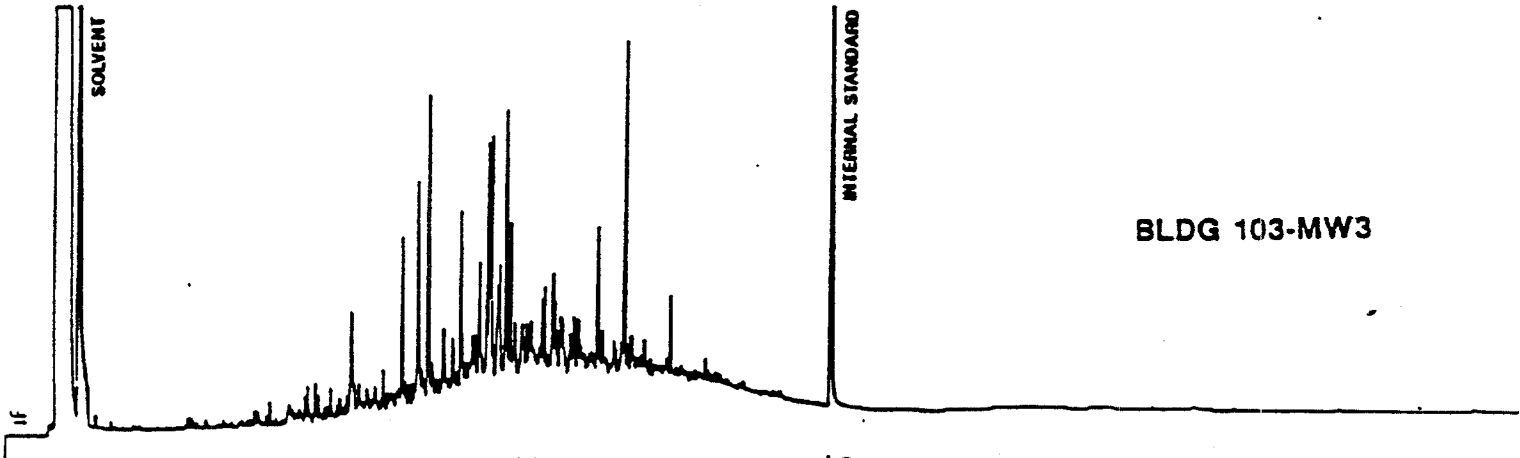
NAVAL AIR STATION KEY WEST,
KEY WEST, FLORIDA

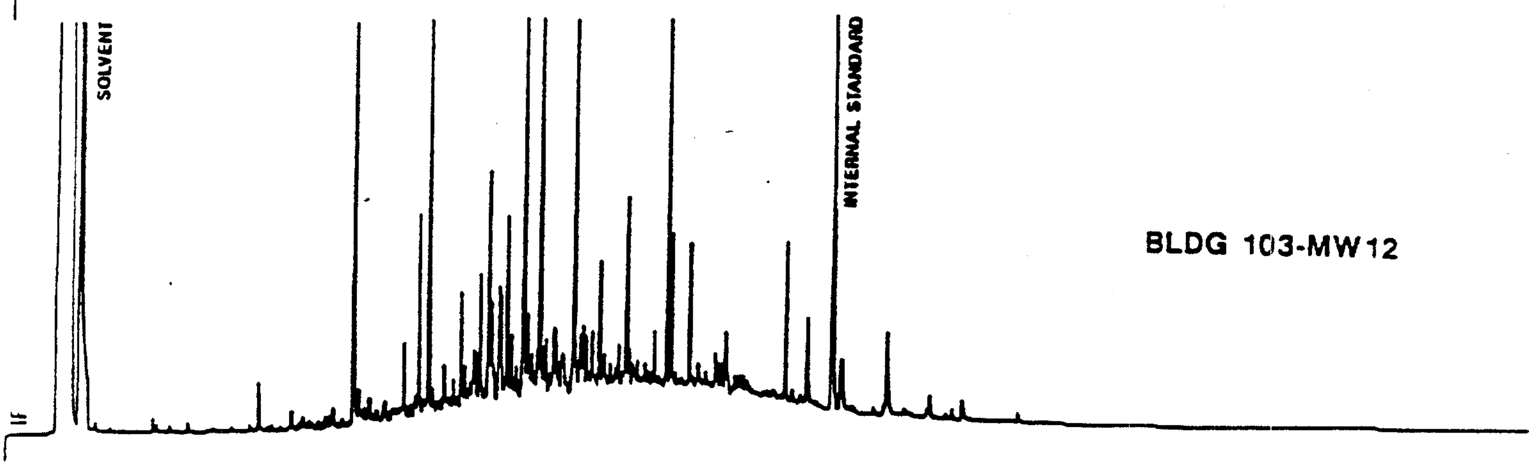
7519-50 931228WEM

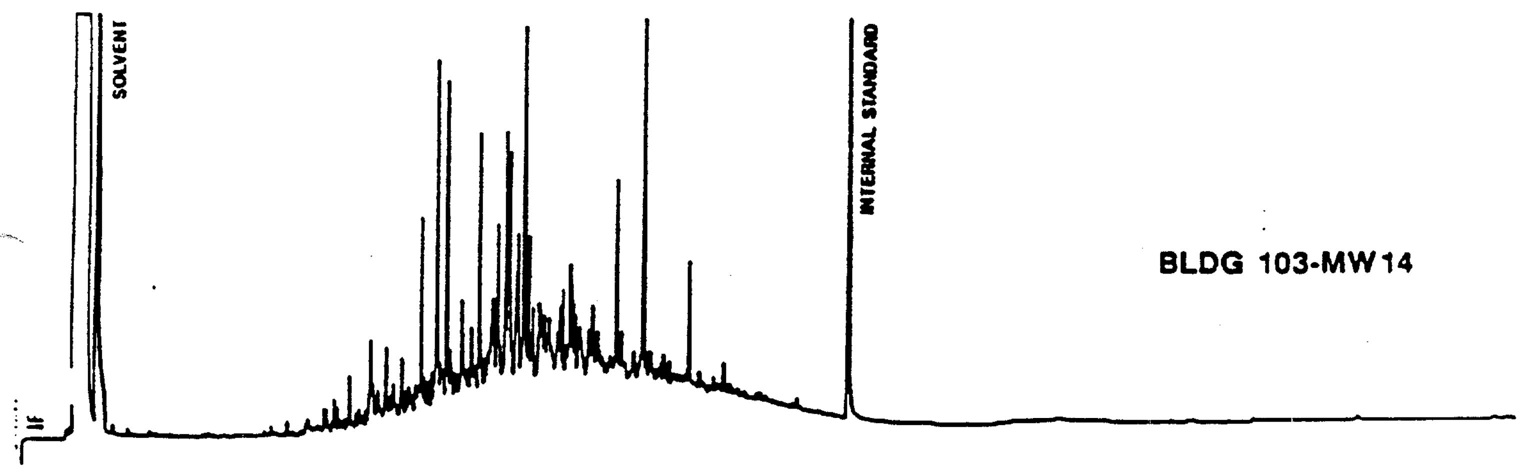
ATTACHMENT 10

PETROLEUM FINGERPRINT
MODIFIED METHOD 3550/8100
Project: NAS-Key West



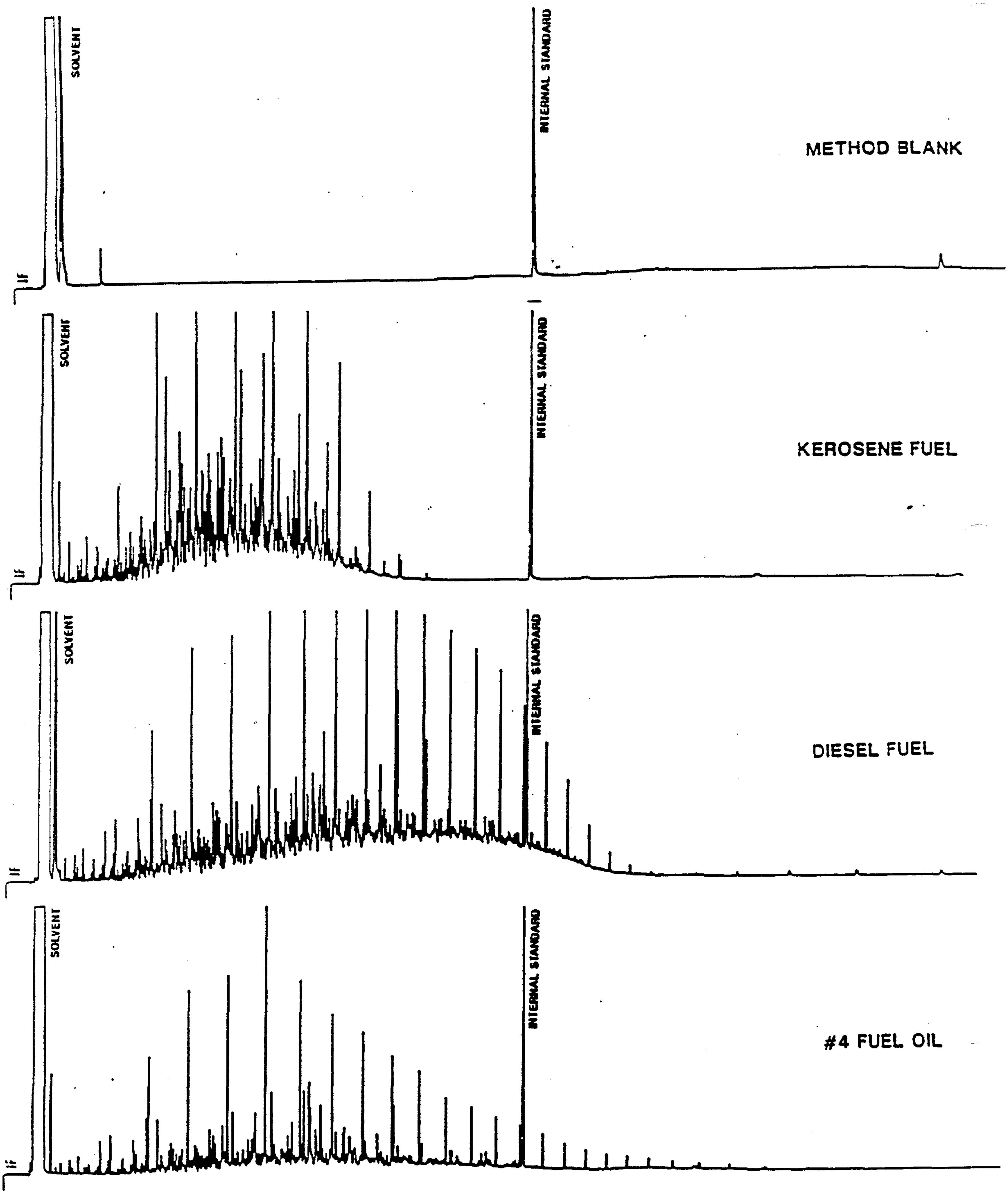






ATTACHMENT 10
(CONTINUED)

PETROLEUM FINGERPRINT
MODIFIED METHOD 3550/8100
Project: NAS-Key West



ATTACHMENT 11

Exposure Assumptions for Calculating Risk-Based Alternative Site Rehabilitation Levels (ASRLs)

1. Soil (Construction Worker):

- No surface soil at the site; all surface soil around site is transported in from other areas.
- Only exposure to soil is during construction; no residential exposure to subsurface soil.
- Construction exposure consists of incidental ingestion, inhalation of particulates release during excavation, and dermal absorption.
- Construction exposure occurs for 30 straight days.
- Exposure consists of exposure to all contaminants detected in either soil or groundwater.
- Standard Risk Assessment Guidance for Superfund (RAGS) Part B exposure equations and input parameters used to establish ASRLs.
- Technical approach and exposure equations similar to those used for RCRA site at Hangar 1000, NAS Jacksonville, Jacksonville, FL, which was accepted by FDEP risk assessment reviewers.

Carcinogenic Effects (Soil):

$$C_{soil}=\frac{TR\times BW\times AT\times 365\,days/year}{EF\times ED[(10^{-6}\times((SF_o\times IR_{soil})+(SF_d\times SA\times AF\times ABS)))+(SF_i\times IR_{air}\times(\frac{1}{VF}+\frac{1}{PEF}))]}$$

where:

C_{soil} Target Chemical Soil Concentration (mg/kg)
TR Target Excess Individual Lifetime Cancer Risk (unitless)
BW Body Weight (kg)
AT Averaging Time (yr)
EF Exposure Frequency (days/yr)
ED Exposure Duration (yr)
SF_o Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$
CF Conversion Factor (10^{-6} kg/mg)
SF_d Dermal Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$
SA Exposed Skin Surface Area (cm^2)
AF Soil Adherence Factor (mg/cm^2)
ABS Skin Absorption (%)
IR_{soil} Soil Ingestion Rate (mg/day)
SF_i Inhalation Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$
IR_{air} Worker Inhalation (m^3/day)
VF Soil to Air Volatilization Factor
PEF Particulate Emission Factor

Attachment II (cont.)

Non-carcinogenic Effects (Soil):

$$C_{soil}=\frac{THI\times BW\times AT\times 365\,days/year}{EF\times ED\times[(10^{-6}\times((\frac{1}{RfD_o}\times IR_{soil})+(\frac{1}{RfD_d}\times SA\times AF\times ABS))+((\frac{1}{RfD_i}\times IR_{air}\times(\frac{1}{VF}+\frac{1}{PEF}))}$$

where:

C_{soil} Target Chemical Soil Concentration (mg/kg)
THI Total Hazard Index (unitless)
BW Body Weight (kg)
AT Averaging Time (yr)
EF Exposure Frequency (days/yr)
ED Exposure Duration (yr)
RfD_o Oral Reference Dose (mg/kg)
CF Conversion Factor (10^{-6} kg/mg)
SA Exposed Skin Surface Area (cm^2)
AF Soil Adherence Factor (mg/cm^2)
ABS Skin Absorption (%)
IR_{soil} Soil Ingestion Rate (mg/day)
RfDi Inhalation Reference Dose (mg/kg)
IR_{air} Worker Inhalation (m^3/day)
VF Soil to Air Volatilization Factor
PEF Particulate Emission Factor

Soil to Air Volatilization Factors

$$VF=\frac{LS\times V\times DH}{A}X\frac{(3.14\times\alpha\times T)^{\frac{1}{2}}}{(2\times D_{ei}\times K_{as}\times 10^{-3}kg/g)}$$

where:

$$\alpha\,(cm^2/s)=\frac{D_{ei}\times E}{E+(p_s)\,(1-E)/K_{as}}$$

VF Volatilization Factor (m^3/kg)
LS Length of Side of Contaminated Area (m)
V Wind Speed in Mixing Zone (m/s)
DH Diffusion Height (m)
A Area of Contamination (cm^2)
D_{ei} Effective Diffusivity (cm^2/s)
E True Soil Porosity (unitless)
K_{as} Soil to Air Partition Coefficient (g soil/cm^3 air)
p_s True Soil Density or Particulate Density (g/cm^3)
T Exposure Interval (s)
D_i Molecular Diffusivity (cm^2/s)
H Henry's Law Constant (atm-m^3/mol)
K_d Soil to Water Partition Coefficient (cm^3/g)
K_{oc} Organic Carbon Partition Coefficient (cm^3/g)
OC Organic Carbon Content of Soil

Attachment 11 (cont)

2. Groundwater (Non-potable Residential Use):

- Following USGS information, groundwater not considered potable water source. Only non-potable water uses considered.
- Non-potable water used in residential setting for washing of outdoor items and irrigation.
- Non-potable exposure consists of dermal contact and absorption of all contaminants detected in groundwater. Contaminants detected in soil are assumed to migrate into groundwater.
- Non-potable groundwater exposure assumed to occur 1 hour per day, 350 days/year, for 30 years.
- Standard Risk Assessment Guidance for Superfund Part B exposure equations used to establish ASRLs.
- Technical approach and exposure equations similar to those used for RCRA site at Hangar 1000, NAS Jacksonville, Jacksonville, FL, which was accepted by FDEP risk assessment reviewers.

Carcinogenic Effects (Water):

$$C_{water} = \frac{TR \times BW \times AT \times 365\,days/year}{EF \times ED \times ET \times [SF_d] \times PC \times 10^{-6} \times SA}$$

where:

C_{water}	Target Chemical Water Concentration (μg/L)
TR	Target Excess Individual Lifetime Cancer Risk (unitless)
BW	Body Weight (kg)
AT	Averaging Time (yr)
EF	Exposure Frequency (days/yr)
ED	Exposure Duration (yr)
ET	Exposure Time (hr/day)
SF_o	Dermal Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$
CF	Conversion Factor (10^{-6} kg/mg)
SA	Exposed Skin Surface Area (cm^2)
PC	Chemical Specific Dermal Permeability Constant (cm/hr)

Attachment 11 (con

Non-carcinogenic Effects (Water):

$$C_{water} = \frac{THI \times BW \times AT \times 365\,days/year}{EF \times ED \times ET \times [\frac{1}{RfD_d}] \times PC \times 10^{-6} \times SA}$$

where:

C_{water}	Target Chemical Water Concentration (μg/L)
THI	Target Hazard Index (unitless)
BW	Body Weight (kg)
AT	Averaging Time (yr)
EF	Exposure Frequency (days/yr)
ED	Exposure Duration (yr)
ET	Exposure Time (hr/day)
RfD_d	Dermal Reference Dose (mg/kg-day)
CF	Conversion Factor (10^{-6} kg/mg)
SA	Exposed Skin Surface Area (cm^2)
PC	Chemical Specific Dermal Permeability Constant (cm/hr)

Department of
Environmental Protection

rec'd Aug. 1, 1994
MED

Lawton Chiles
Governor

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Virginia B. Wetherell
Secretary

July 25, 1994

Mr. Gabriel Magwood
Petroleum Branch
SOUTHNAVFACENGCOM
2155 Eagle Dr., P.O. Box 190010
North Charleston, S.C. 28419-9010

Subject: RAP/Risk Assessment at Site 103. Naval Air Station Key West.

Dear Mr. Magwood:

This letter will serve to confirm the telephone conversation sustained with you and ABB-ES outlining the course of action for the above referenced site.

After consulting with Ms. Ligia Mora-Applegate, the Department's toxicoloist, the following steps regarding this site are listed in order to comply with RUle 17-770 F.A.C.:

1. The Department shall receive, in writing, a request to conduct a Risk Evaluation/Assessment for this site. All pertinent information such as formulas and assumptions to be used should be included to justify this step.

2. As part of the Risk Evaluation, the Navy shall commit to conduct an engineering evaluation of the seawall and appurtenances for permeability and associated geotechnical properties. The evaluation shall be signed and sealed by a Registered Engineer competent in the area. Likewise, the Navy shall commit to an Departmental-agreed periodic inspection/evaluation of the seawall for integrity. The inspection program shall be continued until the levels of constituents in all pertinent monitoring wells are in compliance with Rule 17-302 F.A.C.

3. The Department feels that there is no need to conduct a risk evaluation for soils; therefore, the only step regarding this media is the agreed-before removal of soils around the above ground storage tank.

4. According to Ms. Mora-Applegate, US EPA Risk Assessment Guidelines (RAGS) Part B have changed. It is therefore necessary the ABB-ES toxicologist be aware of these changes.

If I can be of any assistance in this matter please contact me at 904/488-3935.

Sincerely,

Jorge R. Caspary

Jorge R. Caspary, P.G.
Federal Facilities Group

cc: Jorge R. Caspary
Bill Hunt, NAS Key West
Mark Diblin, ABB Tallahassee

An ABB
Environmental
Services, Inc.
Telephone Call MEMORANDUM

ASEA BROWN BOVERI

DATE: 4 August 1994

INCOMING: _X_ OUTGOING: ___

PROJECT: NAS Key West, Site 103

SUBJECT: Items for consideration for present Remedial Action Plan

PARTICIPANTS: Mark Diblin, ABB-ES and Jorge Caspary, FDEP mcD

DISCUSSIONS:

These items are agreed to be the items of concern for the Remedial Action Plan at Site 103. These items are the result of the prior meeting between ABB-ES, FDEP, and SOUTHDIV on 1 July 1994.

1. Soil Contamination:
   a. The RAP must demonstrate no exposure pathway and no risk of contamination to the average construction worker.
   b. The RAP must address source abatement, i.e. disposal of contaminated soil saturated with free product in the vicinity of monitoring well MW-14

2. Groundwater Contamination:
   a. The RAP must assure that the groundwater is not being used as potable water, i.e. there are no potable wells in Key West.
   b. The RAP should provide documentation to support negligible migration of the groundwater and thereby allow for a no further action criteria.
   c. With respect to the bulkhead:
      i. The RAP should show that the bulkhead is impermeable.
      ii. The RAP should include an inspection and monitoring schedule for the bulkhead. The schedule should be set based on technical information concerning the bulkhead design and the bulkhead specifications for integrity over a given period of time.
      iii. Technical reasons justifying the low permeability of the sea wall should be included.

DISTRIBUTION: G. Magwood, Southern Division
M. Dunaway, ABB-ES
J. Caspary, FDEP
M. Dulaney, ABB-ES
J. Ullo, ABB-ES
File

APPENDIX C

ENGINEERING CALCULATIONS

The volume of contaminated soil to be excavated in the area southeast of Building 103 was estimated as shown below.

Using the area associated with the approximate extent of free product shown in Figure B-1, the volume of excavation is estimated.

Area of contamination	=	3240 ft^2
Depth to contamination	=	3 feet
Depth to water	=	6 feet
Depth to water plus 1 ft	=	7 feet
Thickness of contamination	=	4 feet

The volume of contaminated soil =

$$3240\ ft^2 \times 4\ feet = 12960\ ft^3 \approx 480\ yd^3$$

Using a swell factor of 1.12 from the table attached the corrected volume of contaminated soil once excavated would be

$$480\ yd^3 \times 1.12 = 538\ yd^3$$

The volume of soil to be excavated =

$$3240\ ft^2 \times 7\ feet = 22680\ ft^3 \approx 840\ yd^3$$

or with the swell factor:

$$840\ yd^3 \times 1.12 = 941\ yd^3$$

Using the conversion factor, 1 cubic yard of compacted soil weighs approximately 1.5 tons, the mass of contaminated soil is calculated:

$$480\ yd^3 \times 1.5\ \frac{tons}{yd^3} = 720\ tons$$

Percentage Swell and Load Factors of Materials

MATERIAL	SWELL, %	LOAD FACTOR
Cinders	45	0.69
Clay, dry	40	0.72
Clay, wet	40	0.72
Clay and Gravel, dry	40	0.72
Clay and Gravel, wet	40	0.72
Coal, anthracite	35	0.74
Coal, bituminous	35	0.74
Earth, dry loam	25	0.80
Earth, wet loam	25	0.80
Gravel, wet	12	0.89
Gravel, dry	12	0.89
Gypsum	74	0.57
Hardpan	50	0.67
Limestone	67	0.60
Rock, well blasted	65	0.60
Sand, dry	12	0.89
Sand, wet	12	0.89
Sandstone	54	0.65
Shale and soft rock	65	0.60
Slag, bank	23	0.81
Slate	65	0.60
Traprock	65	0.61

Reference:

Florida Department of Environmental Protection, Guidelines for Assessment and Remediation of Petroleum Contaminated Soil, May, 1992.

Merritt, Frederick S., Ed., 1983, Standard Handbook for Civil Engineers, Third Edition: McGraw-Hill Book Co., New York, ch. 13 p. 17.

FREE PRODUCT THICKNESS ESTIMATE
NAS Key West, Building 103, Truman Annex

The measured free product thickness in a monitoring well is an apparent thickness and not the actual thickness of product in the soil. The primary factors which influence the degree of exaggeration in the apparent thickness include grain size and product density. Various methods for estimating the actual thickness are presented in Testa and Winegardner (1991). The following equation, referred to as CONCAWE in that text, may be used.

$$\frac{H}{h} = \frac{P_c^{wo}}{P_c^{oA}} \frac{\rho_o}{\rho_w - \rho_o}$$

where:

- H is the apparent thickness
- h is the actual thickness
- P_c^{wo} is the capillary pressure at the water-oil interface
- P_c^{oA} is the capillary pressure at the oil-air interface
- ρ_o is the density of the product
- ρ_w is the density of water

The specific gravity of the product at this site is estimated to be 0.8. Therefore;

$$\rho_o = 0.8\rho_w \quad and \quad \frac{H}{h} = \frac{P_c^{wo}}{P_c^{oA}} \frac{0.8\rho_w}{\rho_w - 0.8\rho_w} = \frac{P_c^{wo}}{P_c^{oA}} \frac{0.8}{1 - 0.8} = 4 \frac{P_c^{wo}}{P_c^{oA}}$$

Assuming the capillary pressures at the water-oil and oil-air interfaces are equal;

$$\frac{H}{h} \approx 4 \frac{P_c^{wo}}{P_c^{oA}} \approx 4 \quad or \quad h \approx \frac{H}{4}$$

This estimation is consistent with actual measurements referenced in the text and is considered appropriate for this site.

Reference: Testa, S.M., and Winegardner, D.L., 1991, Restoration of Petroleum Contaminated Aquifers: Lewis Publishers, Chelsea, Michigan, 269 p.

FREE PRODUCT VOLUME CALCULATION
NAS Key West, Building 103, Truman Annex

PROJECT: NAS Key West, Building 103, Truman Annex	CHECKED BY: BZ8
DATE: 13 JULY 1994	ENGINEER: FJU

Volume of Free Product:	**219.2 ft ^3**	**or**	**1639.934 gal.**
Mass of Free Product:	**11218.2 lb.**	**or**	**5088.576 kg**

The estimated thickness and extent of apparent product at Building 103 is illustrated in Figure B–1.
In August, 1993 free product was detected in monitoring well MW–14 with a thickness of 1.29 feet
The volume of actual free product saturated soil has been estimated in the table using the average end area method.

BUILDING 103, TRUMAN ANNEX

Apparent Thickness (ft)	Actual Thickness (ft)	Area (ft^2)	Average Area (ft^2)	Incremental Volume (ft^3)	Cumulative Volume (ft^3)
0.00	0.00	2916.0			
0.65	0.16	1504.0	2210.0	359.1	359.1
1.29	0.32	480.0	992.0	158.7	517.8

Volume of Soil Saturated with Product: 877.0 ft^3

Free Product Volume*: 219.2 ft^3

*Total Volume multiplied by the porosity which is estimated to be 0.25.

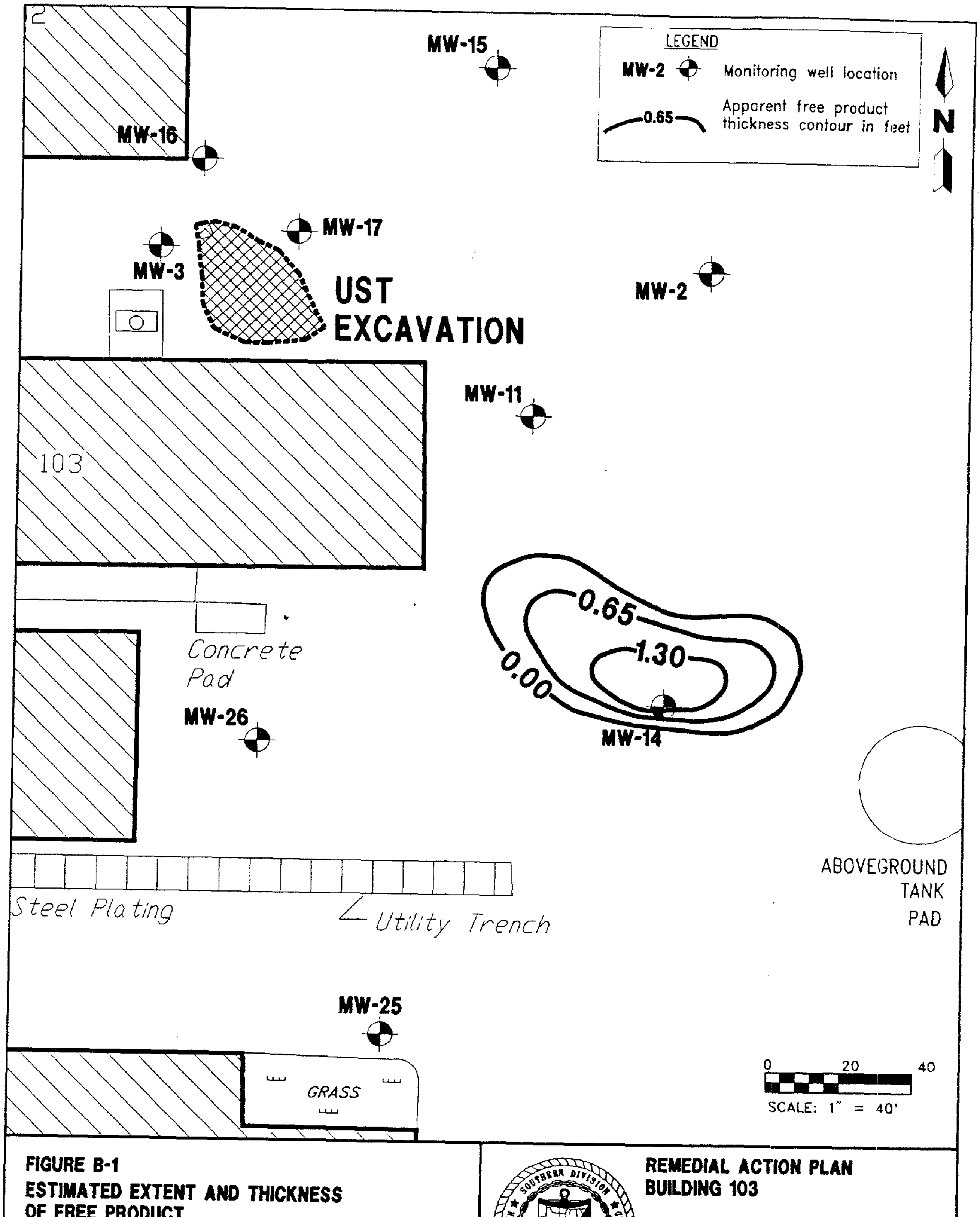


FIGURE B-1
ESTIMATED EXTENT AND THICKNESS OF FREE PRODUCT

KEYWEST\BLDG-103\WDW\08-24-94

REMEDIAL ACTION PLAN
BUILDING 103

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

APPENDIX D

LISTING OF PERMITTED SOIL THERMAL TREATMENT FACILITIES

SOIL THERMAL TREATMENT FACILITIES
QUALIFIED TO OPERATE UNDER A GENERAL PERMIT
CHAPTER 17-775, F.A.C.

July 1, 1993

Stationary Facilities:

Central District:

Southern Soil Services, Inc.
3505 Pug Mill Road
Kissimmee, FL 32741
(407)933-8414

C.A. Myer Paving & Construction
Post Office Box 555727
Orlando, FL 32855-5727
(407)849-0770

Northwest District:

Sonas Systems of Florida
(Capital Asphalt, Inc.)
Post Office Box 7387
Tallahassee, FL 32314-7387
(904)575-8102

Industrial Waste, Inc.
Ellyson Industrial Park
Post Office Box 34
Pensacola, FL 32514
(904)479-1788

Southeast District:

Rinker Materials Corporation
1200 Northwest 137th Avenue
Post Office Box 650679
Miami, FL 33265-0679
(305)221-7645

TPS Technologies, Inc.
9401 Fairgrounds Road
West Palm Beach, FL 33411
(407)433-2650

Northeast District:

Anderson Columbia Company
Post Office Box 1386
Lake City, FL 32056
(904)752-7585

South District:

South Florida Thermal Services
1 Foxmoor Lane
Post Office Box 309
Moore Haven, FL 33471
(813)946-3300

Southwest District:

Kleen Soil International, Inc.
13838 Harlee Road
Palmetto, FL 34221
1-800-926-9677

Geologic Recovery Systems
2300 Highway 60 West
Mulberry, FL 33860
(813)425-0184

Mobile Facilities:

Carlo Environmental Technologies
Model No. 64MT, Serial No. 43543
Post Office Box 744
Clinton, MI 48038-0744
(313)468-9580

D.R.E. Environmental, Inc.
Model No. 528
Post Office Box 1386
2 Guerdon Road
Lake City, FL 32056
(904)755-1196

Mobile Reclaim, Inc.
Serial No. SR-202
Post Office Box 4189
Gainesville, FL 32613-4189
(904)373-4614

Thermotech Systems Corp.
Model No. 625
5201 N. Orange Blossom Trail
Orlando, FL 32810
(407)290-6000

TPS Technologies, Inc.
Serial No. SRU-200P-103 thru
SRU-200P-110
2070 South Orange Blossom Trail
Apopka, FL 32703
(407)886-2000

APPENDIX E

BASIS OF DESIGN